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# 1990 Report on USDA Human Nutrition Research and Education Activities

A Report to Congress





## PREFACE

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This report was prepared under the auspices of U.S. Department of Agriculture's (USDA's) Subcommittee for Human Nutrition, Research, and Education Committee of the Secretary of Agriculture's Policy and Coordination Council.

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Agency Abbreviations

<u>Agency</u>	<u>Agency Abbreviation</u>
Agricultural Marketing Service	AMS
Agricultural Research Service	ARS
Cooperative State Research Service	CSRS
Economic Research Service	ERS
Extension Service	ES
Food and Nutrition Service	FNS
Food Safety and Inspection Service	FSIS
Human Nutrition Information Service	HNIS
National Agricultural Library	NAL

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## EXECUTIVE SUMMARY

### Introduction

In accordance with the provisions of section 1452(b) of the National Agricultural Research, Extension, and Teaching Policy Act Amendments of 1985 (7 U.S.C. 3173 note), this report on the human nutrition research and education activities of the Department of Agriculture for FY 1990 is hereby submitted. This is the fourth annual report in which emphasis is placed on directions and highlights with no effort made to restate the Department's detailed plan, outlined in the report submitted in 1986.

### Contents of Report

New human nutrition research projects initiated, research highlights, and other research findings during FY 1990 for USDA agencies are presented by research areas as follows:

- o Normal Requirements for Nutrients
- o Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders
- o Food Composition and Nutrient Bioavailability
- o Food and Nutrition Monitoring Research
- o Food and Nutrition Information and Education Research
- o Food Marketing and Demand
- o Research on Government Policies and Socioeconomic Factors

The numbers of USDA research projects included in the Human Nutrition Research Information Management System in December 1990 are shown by Federal nutrition code category. The Food and Nutrition Information and Education programs within USDA also are summarized by new initiatives and ongoing programs to meet their clients' needs. During FY 1990, improved communication exchange and cooperation among agencies on information and education activities was strengthened. Again, emphasis was given to ensure that the Federal Government "speaks with one voice" when issuing dietary guidance.

Human nutrition research and education activities in USDA continued to be linked with the nutritive value of foods, human nutritional needs, the kinds and amounts of foods that Americans consume relative to their needs, and strategies for improving diets and the food supply. The major role of USDA is to help individual consumers understand the relationship of food and its nutrients to the maintenance of health and the prevention of diet-related disorders during the different stages of life. Since consumers' demands drive the marketplace, the importance of sound, research-based nutrition education programs for consumers, as well as for food producers and processors, is obvious.

### Funding Levels

The actual or estimated expenditures for human nutrition research and human nutrition information and education by the several USDA agencies for fiscal years 1986 through 1991 are given. The total amount of human nutrition research support by USDA has increased from \$60.8 million in FY 1986 to \$74.9 million in FY 1991, an increase of 23 percent. During the same period, USDA support for human nutrition information and education has increased from \$133.2 million to \$180.6, an increase of 35.6 percent. Most of the funds for information and education activities were distributed to and managed by State agencies. The total USDA support for human nutrition in FY 1990 was \$230.8 million and is estimated to be \$255.5 million in FY 1991.

### Coordination

Continued progress was made during FY 1989 in achieving coordination within the Department of Agriculture, with other Departments, and with the private sector and international organizations, thus helping to provide the best services possible within available resources. A description of coordinating mechanisms in place during FY 1990 and the specific recommendations made by outside advisory groups are also included in the report.

### Benefits

The potential benefits of improved diets and nutritional status are better health and a longer, more active, and more satisfying life. The development of new information to fill knowledge gaps, as well as the application of existing knowledge, is essential to the prevention of diet-related health problems and to increased performance and satisfaction.

# 1990 ANNUAL REPORT ON USDA HUMAN NUTRITION RESEARCH AND EDUCATION ACTIVITIES

## A REPORT TO CONGRESS

### I. INTRODUCTION

#### A. Charge

In accordance with the provisions of section 1452(a) of the National Agricultural Research, Extension, and Teaching Policy Act Amendments of 1985 (7 U.S.C. 3173 note), a U.S. Department of Agriculture (USDA) comprehensive plan for implementing a national food and human nutrition research and education program was submitted to Congress in December 1986. Section 1452(b) of this Act requires the Secretary annually thereafter to submit a report on the human nutrition research activities conducted. Such reports, prepared under the auspices of USDA's Subcommittee for Human Nutrition, Research, and Education Committee of the Secretary's Policy and Coordination Council, have been submitted for fiscal years 1987, 1988, and 1989. This report covers the Department's activities in human nutrition research and education for fiscal year 1990. As before, emphasis is given to new directions and accomplishments during the year. The 1986 report gives the detailed program plan components.

#### B. Legislative

##### 1. Special Supplemental Food Program for Women, Infants, and Children (WIC) Legislation

The Child Nutrition and WIC Reauthorization Act of 1989, Public Law 101-147, contains nearly 70 separate WIC-related provisions, many of which impact significantly on program operations. Major provisions contained in P.L. 101-147 include:

- a) new time frames for allocating program funds and a new administrative funding formula;
- b) cost-containment requirements for States to implement competitive rebate systems for the acquisition of infant formula;
- c) the establishment of "adjunct" (i.e., automatic) WIC income eligibility for food stamp, Aid for Dependent Children (AFDC), and Medicaid recipients, as well as for members of families including an AFDC recipient or a pregnant woman or infant who receives Medicaid;
- d) improved WIC Program referral, access, and certification procedures;
- e) emphasis on breastfeeding promotion activity; and
- f) requirements for the Department to examine critical aspects of program operations, specifically the relationship between nutritional risk criteria and the WIC priority system (especially as it affects pregnant women), the content and effectiveness of the WIC food packages, and the effects of the provisions of P.L. 101-147 on WIC administrative and nutrition services costs.



## 2. Nutrition Education and Training Program (NET) Reauthorization

The Nutrition Education and Training Program (NET), established in 1977, was reauthorized for 5 years, fiscal years 1990 through 1994, by the Child Nutrition Act as amended by Public Law 101-147, November 10, 1989. The NET Program aims to build good food habits by teaching the fundamentals of nutrition to children, parents, educators, and school food service personnel through grants to State agencies. NET reaches children by coordinating learning experiences in the classroom, the school cafeteria, and the community. Teachers and school food service employees receive appropriate instruction in nutrition, nutrition education, and food service management. Parent involvement in NET activities is an important aspect of the program.

During fiscal year 1990, 55 State or territorial agencies are participating in the NET Program.

## 3. Nutrition Education and Training Program (NET) Regulation Amendment

In response to the statutory mandate of Public Law 101-147, the National School Lunch Act was amended to require:

- a) school food service personnel be trained in the principles and practices of food service management, in cooperation with materials developed at any food service management institute established as authorized by section 21(a) (2) of the National School Lunch Act,
- b) nutrition education activities be conducted in institutions offering summer food service programs, as well as at schools and child care institutions,
- c) deletion of the State Plan requirement to solicit advice from the National Advisory Council on Child Nutrition, because the Council has been dissolved,
- d) States to modify their NET plans annually, rather than resubmitting the entire plan each year. The States were required to submit a full plan for fiscal year 1990, the first year of the next 5-year reauthorization. Thereafter, for the remainder of this reauthorization period, the States shall submit annual updates before August 15 to modify those elements of the plan which must be changed to reflect the findings of the State's annual evaluation and updated needs assessment. An annual budget shall be submitted within 30 days of receipt of the final grant allocation based on annual enrollment data.

## 4. Nutrition Guidance for Child Nutrition Programs

P.L. 101-147 mandated that the Departments of Agriculture and Health and Human Services jointly develop and distribute a publication entitled "Nutrition Guidance for Child Nutrition Programs." It is intended that school food

authorities and other organizations and institutions participating in Child Nutrition Programs apply the nutrition guidance described in the publication when preparing meals and supplements served under the programs.

#### 5. Nutrition Monitoring

Public Law 101-445, the "National Nutrition Monitoring and Related Research Act of 1990" passed by Congress and signed into law by the President, has considerable effect on the programs of the Human Nutrition Information Service (HNIS), the USDA lead agency for nutrition monitoring and development and implementation of the Dietary Guidelines for Americans. The act requires the Secretaries of the U.S. Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS) to establish and implement a comprehensive plan for the coordinated National Nutrition Monitoring and Related Research Program with numerous components, to establish a nine-member National Nutrition Monitoring Advisory Council, to report to Congress biennially on the progress of the coordinated program including annual reports from the Council, to jointly publish Dietary Guidelines for Americans every 5 years, and to review and approve all Federal dietary guidance prior to publication, with provision for a public comment period on such guidance if disapproved by either Secretary. HNIS is working jointly with the Department of Health and Human Services to implement the statutory requirements of the National Nutrition Monitoring and Related Research Act of 1990.

## C. Changes in Resources or Infrastructure

### 1. Special Supplemental Food Program for Women, Infants, and Children (WIC)

#### a. Cost Containment

Funds generated through cost containment efforts implemented by WIC State agencies continue to be substantial and are having a significant impact on the program. The most popular cost containment initiative has been infant formula rebate systems. Currently, 74 of 87 State agencies operate an infant formula rebate system pursuant to P.L. 100-237. Projected savings from infant formula rebates for FY 1989 were \$250 million; actual savings were \$293,019,162. For FY 1990, as of May, preliminary reports indicate that over \$227 million has been saved. These savings, plus steadily increased appropriations--from FY 1985 to 1990, WIC has experienced a 29 percent increase in appropriations--have caused a substantial increase in participation. In FY 1989, the WIC Program provided benefits to 4.1 million participants. As of May 1990, participation had reached an all-time high of nearly 4.5 million participants.

#### b. Drug Abuse Information

The legislative mandate requiring the WIC Program to provide drug abuse information and referrals for counseling and treatment authorized an amount, not to exceed \$10 million of the program appropriation, to be used for this purpose in FY 1989, and amounts as appropriate for subsequent fiscal years. Program funds used for such activity were \$1.1 million for FY's 1989 and 1990.

#### c. Farmers' Market Coupon Demonstration Projects

Legislation was enacted by Congress authorizing WIC to carry out Farmers' Market Coupon Demonstration Projects. Under these demonstrations, WIC clients were given coupons to redeem at participating farmers' markets for fresh fruits and vegetables. Initial funds to be appropriated by Congress for this purpose were \$2 million for FY 1989, \$2.8 million for FY 1990, and \$3.5 million for FY 1991. Actual funds appropriated by Congress for such activity were \$2 million for each of FY's 1989 and 1990.



## II. HUMAN NUTRITION RESEARCH ACTIVITIES

### A. General

Human nutrition research and education in USDA has traditionally been linked with the nutritive value of foods, human nutritional needs, the kinds and amounts of foods that Americans consume relative to their needs, and strategies for improving diets and the food supply. A major effort in USDA is to understand the relationship of food and its nutrients to health promotion in individuals at all stages of life.

The application of new nutritional knowledge often leads to changes in kinds and amounts of foods people consume, and hence often the demand for food. Similarly, any improvement of the nutritional quality of the foods we eat must involve corresponding changes in the agricultural food system. Hence, the nutrition of individuals or of population groups depends on a host of factors that occur in the "food chain" before food becomes available for consumption, i.e., during production, processing and storage, and marketing. To ensure an adequate supply of high quality foods, an intimate knowledge of food composition, of the biological effects of food constituents, and of nutritional requirements and tolerances of humans is needed. This knowledge can be derived only through interdisciplinary efforts, interfacing nutrition research with pre- and post-harvest agricultural science and technology.

The human nutrition research activities during FY 1989 are presented under six areas as detailed in the national plan. These are:

- o Normal Requirements for Nutrients
- o Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders
- o Food Composition and Nutrient Bioavailability
- o Food and Nutrition Monitoring Research
- o Food and Nutrition Information and Education Research
- o Research on Government Policies and Socioeconomic Factors

It is important to note that the USDA research activities also fit well into the Federal 5-Year Plan, released by the Interagency Committee on Human Nutrition Research (ICHNR) in 1986. USDA does not conduct research on the role of nutrients in the treatment of chronic diseases or disorders. It does, however, support some research on health promotion or prevention of nutrition-related disorders, especially as related to fats, fiber, and complex carbohydrates and other components of foods and diets. The USDA program focuses especially on normal nutrient requirements and content and bioavailability of nutrients in foods.

A computer search was made on December 5, 1990, of ongoing research in USDA relating to human nutrition, using the Human Nutrition Research Information Management System (HNRIMS). Table 1 shows the number of USDA research projects in most of the nutrition code categories under each of the six

research areas listed. The table also shows the percentage of the total number of USDA projects that were coded for each of the categories. In addition, the percentage of the total number of research projects in HNRIMS for all Federal agencies which are USDA-supported projects is given by nutrition code category. The USDA projects include those conducted by the USDA agencies, the State Agricultural Experiment Stations, and the 1862 and 1890 land-grant institutions and Tuskegee University. Some of these projects receive no Federal funds. The total Federal funds expended by USDA for human nutrition research in FY 1990 was \$230.7 million (see table 2, section IV).

The Agricultural Research Service (ARS) is the principal intramural research agency of the Department. Its research in human nutrition is conducted largely at five separate Human Nutrition Research Centers and at Regional Research Centers. The Centers maintain close communication with each other, and the research programs are coordinated through the National Program Staff. Each Center has a different research thrust and provides its unique contribution in solving high priority national problems. The locations and primary missions of the ARS Human Nutrition Research Centers are listed:

Beltsville Human Nutrition Research Center, Building 308, BARC-East, USDA-ARS, Beltsville, MD 20705; Dr. Walter Mertz, Director, 301/344-2157. Its history can be traced to 1894 at Wesleyan University at Middletown, CT. A move was made to Washington, DC, in 1906 and to Beltsville, MD, in 1941. Research is conducted on nutrient composition and nutritional qualities of food. Studies are performed on energy metabolism and nutritional requirements. Dietary strategies are developed, which can delay the onset of nutritionally related chronic diseases.

Grand Forks Human Nutrition Research Center, P.O. Box 7166, University Station, USDA-ARS, Grand Forks, ND 58202; Dr. Forrest Nielsen, Director, 701/795-8456. It was established in 1970. The focus is on defining human requirements for trace elements and the physiological and biochemical factors which influence those requirements.

Western Human Nutrition Research Center, P.O. Box 29997, USDA-ARS, Presidio of San Francisco, CA 94129; Dr. James Iacono, Director, 415/556-9697. It was established in 1980. Improved methods are developed for monitoring and evaluating nutritional status, and factors that lead to malnutrition are investigated. Studies on human nutritional requirements are conducted.

Human Nutrition Research Center on Aging at Tufts University, USDA-ARS, 711 Washington Street, Boston, MA 02111; Dr. Irwin Rosenberg, Director, 617/556-3330. It was established in 1979. Research is conducted on the special nutritional needs of persons as they age with a view toward enhancing the quality of later life through improved nutrition and health.

Children's Nutrition Research Center, 1100 Bates Street, USDA-ARS, Houston, TX 77030; Dr. Buford Nichols, Director, 713/798-7000. It was established in 1979 in connection with Baylor University. The focus is on determining the unique nutrient needs of pregnant and lactating women and of children from conception through early years of development.



Table 1. USDA Research in Human Nutrition  
(from HNRIMS, December 5, 1990)

<u>HNRIMS Nutrition Code Area</u>		<u>USDA Projects*</u>		<u>USDA Projects as</u>
% of Federal		<u>Number</u>	<u>%</u>	<u>Research in Area</u>
<u>Normal Human Requirements for Nutrients</u>				
1. Maternal	42	4.5	20	
2. Infant and Child	56	6.0	15	
3. Adolescent	19	2.0	23	
4. Adult	77	8.2	55	
5. Elderly	36	3.8	26	
10. Immunology, Nutrition, & Infection		15	1.6	10
12. Genetics and Nutrition	21	2.2	10	
13. Nutrition and Function	124	13.2	37	
14. Nutrient Interactions	122	13.0	28	
15. Other Conditions & Nutrition		40	4.3	6
<u>Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders</u>				
6. Cardiovascular Disease and Nutrition		54	5.7	10
7. Cancer	36	3.8	6	
8. Other Diseases (Osteoporosis, Diabetes)		31	3.3	5
9. Trauma & Nutrition	5	0.5	16	
11. Obesity, Anorexia, and Appetite Control		28	3.0	8
17. Carbohydrates	76	8.1	32	
18. Lipids	156	16.6	26	
19. Alcohols	2	0.2	3	
20. Proteins and Amino Acids		130	13.8	29
21. Vitamins	108	11.5	19	
22. Minerals and Trace Elements		163	17.3	31
23. Water and Electrolytes	17	1.8	12	
24. Fiber	35	3.7	50	
25. Other Nutrients in Foods		50	5.3	41
<u>Food Composition and Bioavailability of Nutrients</u>				
26. Food Composition	238	25.3	82	
27. Bioavailability of Nutrients		113	12.0	73
28. Effects of Technology on Nutritional Characteristics of Food		255	22.1	85
29. Other Food Science Research		87	9.3	74
<u>Food and Nutrition Monitoring Research</u>				
16. Nutritional Status	155	16.5	44	
30. Food Consumption Surveys		52	5.5	66
31. Dietary Practices, Food Consumption Patterns	125	13.3	36	
<u>Food and Nutrition Information and Education Research</u>				
32. Methods for Informing Public About Nutrition	31	3.3	42	
33. Other Nutrition Education Research		19	2.0	49
<u>Effects of Government Policy and Socioeconomic Factors</u>				
34. Effects of Government Policy and Socioeconomic Factors on Food Consumption and Nutrition		45	4.8	80

\*Numbers are not additive as projects may be assigned more than one nutrition code (940 USDA research projects in system).

The Cooperative State Research Service (CSRS) is the Agency in the U.S. Government that serves as an interface and coordinating mechanism between the U.S. Government research organizations, the 59 designated States and territorial agricultural experiment stations, and the 1890 Colleges and Tuskegee. Money is appropriated by Congress and administered by the Secretary of Agriculture through the Cooperative State Research Service to each of the stations on a formula basis. Before the States can spend the money, they submit projects which must be approved by CSRS for funding. The States have a large degree of freedom in spending the money other than submitting projects for approval and submitting annual progress reports. National research priorities are recommended by the State experiment directors to the Department of Agriculture and then incorporated into the Department's annual request for funds from Congress.

Five regional research projects typify areas of nutrition research currently underway at State agricultural experiment stations in cooperation between ARS and HNIS. These are: (1) Nutrient Bioavailability, which involves the cooperative efforts of 10 States and ARS; (2) Health Maintenance Aspects of Dietary Recommendations Designed To Modify Lipid Metabolism, which involves 10 States and ARS, and deals with the nutrition aspects of individuals' health and well-being; (3) Behavioral and Health Factors That Influence the Food Consumption of Young Adults (5 States and HNIS); (4) Nutritional Assessment in Older Adults: Diet Intake and Biochemical Studies (9 States, HNIS, and ARS); and (5) Dietary Fat and Fiber: Knowledge, Perceived Risk, and Dietary Practices (12 States and HNIS). The latter three regional projects deal with problems and opportunities to bring about the use of better nutritional practices in the general population.

In addition, numerous individual research projects encompass the entire spectrum of nutrition research. A recent development is the establishment of a Center for Designing Foods To Improve Nutrition at Iowa State University. CSRS also administers the Competitive Research Grants Program in human nutrition through its Competitive Research Grants Office.

B. Normal Requirements for Nutrients (ARS, CSRS)

1. Competitive Research Grants Program

The Human Nutrient Requirements Program of the Competitive Research Grants Office, CSRS, awarded \$1,403,988 in grant support for 17 projects in FY 1990. The findings will increase our understanding of requirements for nutrients and help fill the gaps about nutrient bioavailability, nutrient interrelationships, and the nutritive value of foods consumed with different patterns of intake in the United States. The following projects were funded in FY 1990:

- o Response of Mexican Children to Zinc and Iron Supplements, \$143,750/3 years.
- o Zinc Requirement as Estimated by Erythrocyte Metallothionein, \$50,493/2 years.
- o Selenium: Single Nutrient Regulation of Glutathione Peroxidase, \$75,000/1 year.
- o Effect of Zinc Deficiency on Pancreatic Insulin Metabolism, \$94,188/2 years.
- o Role of Carnitine and Acetylcarnitine in Host Defense Processes of Human MNP, \$87,250/2 years.
- o Induction of Carnitine Acyltransferases by Fatty Acids and Metabolites, \$36,000/2 years.
- o Binding of Cobalamins to Transcobalamin-II: A Biophysics Study, \$48,684/1 year.
- o FASEB Summer Research Conference on Retinoids, \$6,000/1 year.
- o Zinc Deficiency: Its Effect on Vitamin A Transport, \$78,185/2 years.
- o Neural Responses to Disproportionate Amino Acid Diets: Role of Monoamines, \$186,960/3 years.
- o Postprandial Lipemia: Response to Dietary Fiber, \$86,707/2 years.
- o Assay of Cis-Carotene Isomers in Human Plasma, \$47,500/2 years.
- o Kinetic Analysis of Zinc Metabolism, Status, and Requirements, \$98,598/2 years.
- o Use of Cysteine Pro-Drugs Versus Sulfur Amino Acids as a Source of Cysteine, \$109,524/2 years.
- o Aging and Vitamin B6 Bioavailability, \$43,611/1 year.
- o Cellular and Molecular Analysis of Placental Calcium Transport, \$43,882/1 year.



- o Influence of Pregnancy on Selenium Metabolism in Women of Low Selenium Status, \$167,656/3 years.

Results from ongoing intramural and other extramural research supported by USDA are given in the following sections.

## 2. Infants and Children

### o Acid-Base Status of Premature Infants Requires Monitoring

Premature infants, fed intravenously, receive a nutritive solution that contains calcium, phosphorus, other minerals, and amino acids that are important to the growth and development of bones. To ensure that such infants can absorb enough calcium and phosphorus from the solution, it is sometimes made more acidic. Increasing the acidity of the solution, however, may lead to excessive acidity of the fluids in an infant's body. Another substance, acetate, may then be added to reduce the acidity of the nutritive solution. An investigation was done to determine how often acetate was required to maintain an acid-base balance in infants whose intravenous solution had been made acidic. It was found that acetate was often required under such circumstances. It is suggested that the acid-base status of any newborn infant whose nutritive solution has been made acidic be monitored carefully.

### o Vitamin B6 Metabolism in Premature Infants

Babies born prematurely (less than 36 weeks of gestation) have an increased incidence of convulsive seizures and long-term neurological problems compared with full-term infants. The symptoms are similar to those observed in infants with severe vitamin B6 deficiency. For this reason, the metabolism of vitamin B6 in premature infants was investigated. It was found that the concentration of the active form of the vitamin, pyridoxal phosphate, in serum was extremely low even though the infants were receiving vitamin B6 intravenously. In several infants receiving intravenous feedings, the normal form of vitamin B6 (pyridoxine) was replaced with another form (pyridoxal) which requires less changes for conversion to the active form of the vitamin. The resulting concentrations of pyridoxal phosphate in the blood of the two groups were compared. There was a negligible serum pyridoxal phosphate response in both groups. However, red blood cell pyridoxal phosphate and whole blood total vitamin B6 concentrations increased in both groups following initiation of feeding. These findings indicate that premature infants do not have an impaired ability to convert pyridoxine to its active form. The presence of large amounts of both pyridoxal phosphate and total B6 vitamers in whole blood indicates that there were substantial amounts of the vitamin in the circulation of these infants. While the functional significance of these findings is unknown, it appears that in the premature infant, serum pyridoxal phosphate is not an appropriate indicator of vitamin B6 status.

### o Energy Expenditure and Growth of Infants

The response of human infants to severely restricted caloric intake, malnutrition, is well documented. We do not, however, know much about how caloric intakes that are different, but presumably adequate, affect activity and growth in infants. Energy intake was calculated from 5-day test-weighing

records or pre- and post-weighing of bottles, in combination with bomb calorimetry of the milks. Total daily energy expenditure was determined by the doubly labeled water method. Sleeping metabolic rate and minimal observable energy expenditure were measured by indirect calorimetry. Activity was estimated by difference. Energy deposition, estimated from dietary intake less total daily energy expenditures, was significantly higher at 1 and 4 months for the formula-fed than for the breast-fed infants. Different levels of caloric intake were studied in forty 1-month-old and 4-month-old breast-fed and formula-fed infants to explore differences in energy utilization. It was found that a higher caloric intake resulted in greater weight gain and energy deposition and an increase in energy use while sleeping; it did not, however, result in an increase in physical activity. The authors conclude that an infant's adaptation to varying levels of caloric intake appears to be mediated through growth and basal-energy-requiring processes, but not through physical activity.

o Lactoferrin from Colostrum Stimulates Growth

The protein lactoferrin is present in the milk of mammals and is believed to function in the gut of young mammals by enhancing (1) the absorption of iron from milk, and (2) the suppression of bacterial growth. Lactoferrin may also stimulate the early growth and development of the gut in young mammals. Lactoferrin, identified in human colostrum, was found to increase the incorporation of thymidine into the DNA. The lactoferrin-stimulated thymidine incorporation was examined by comparing the effects of iron-free lactoferrin with those of iron-saturated lactoferrin under conditions which inhibit the transfer of iron between these iron-binding proteins. In addition, the dose-response relationships of diferric lactoferrin and apolactoferrin were compared. The results demonstrated that lactoferrin, independent of iron-binding state, is a growth agent and promotes the incorporation of thymidine into the DNA of rat crypt enterocytes. These findings suggest a hitherto unreported nutritional role for lactoferrin, independent of its iron-binding capacity. If the growth-inducing property of lactoferrin is confirmed, it might be useful in formulas for premature infants.

o Low Zinc and Vitamin A Status of School Children in Northeast Thailand

Several studies involving animal models suggest an interaction between vitamin A and zinc metabolism. Lack of zinc in the diet may inhibit vitamin A transport and function in night vision. A study was designed to determine the prevalence of suboptimal zinc and vitamin A status in a population eating a diet mainly of rice with little meat, eggs or dairy products. Thailand was chosen because the staff of the Nutrition Institute, Mahidol University, is well trained, and a high prevalence of vitamin A and zinc deficiencies was suspected. The results revealed that 70 percent of the children had low plasma zinc and about one-fourth of these had low serum vitamin A levels. The mean concentration of retinol-binding protein was lower for children in this study than for healthy Thai children in Bangkok. Serum zinc and retinol binding protein was found to be significantly correlated, whereas serum vitamin A and zinc were not. These data indicate that a high proportion of rural school children in Northeast Thailand are at risk of inadequate zinc and/or vitamin A nutriture.



- o Effect of Carbohydrate Level on Absorption in Infants With Diarrhea

Malnourished infants with severe, chronic diarrhea frequently cannot absorb carbohydrate consumed as a part of their diet. Low-carbohydrate and high-carbohydrate diets were fed in random order to two groups of infants hospitalized with malnutrition and diarrhea to determine which diet would be better absorbed (tolerated). The higher level of carbohydrate replaced fat in these diets. The low-carbohydrate formula was tolerated better and resulted in better absorption of nutrients as indicated by a significantly higher coefficient of fat absorption and lower amount of total fecal energy.

### 3. Maternal Nutrition

- o Energy Needs Increase During Lactation

It is not known precisely how many calories a mother who is breastfeeding her child should eat to maintain both adequate milk production and her own good health. Therefore, the energy needs of breastfeeding women were studied. Basal and postprandial metabolic rates were determined by indirect calorimetry in lactating, nonlactating postpartum, and nulliparous women who received a controlled diet which provided 1.0 g/kg/d of protein and energy that approximated usual intake levels based on diet records. Milk production was measured by the test weighing procedure and milk expression. Despite higher energy intakes in lactating women, basal metabolic rates were similar among all groups. No relationships were detected between basal metabolic rates and postpartum time in lactating women. In contrast, postprandial metabolic rates were significantly increased in lactating, compared with nonlactating, women. Milk nitrogen, but not energy, concentrations showed a linear relationship with postprandial metabolic rates ( $r = 0.86$ ). The energy cost of milk production was estimated to be 80 percent. Thus, increased energy needs during lactation are associated not only with milk production, but also with elevated postprandial metabolic rates. This was met by an increase in dietary energy intakes of 50 percent above the intakes of nonlactating controls. This information will be useful in designing further research to determine the energy requirements of mothers who breastfeed their children.

- o Dietary Fat Intake and Cholesterol Synthesis by Lactating Mothers

Cholesterol, although implicated in heart disease, is an essential nutrient for human growth, and it is produced in human milk in high concentrations. Relative to its weight, a 4-month-old breast-fed infant consumes four times the amount of cholesterol that is recommended for adults. Because all human tissues are capable of making cholesterol, however, it is not considered a dietary essential. Two studies were conducted at 3 or 4 months postpartum in lactating women to measure the amount of cholesterol produced by the human mammary gland and to determine if the amount of fat in the diet of nursing mothers would have an effect on the production of cholesterol. All mothers consumed alternatively a high-fat (40 percent of calories) and a low-fat (10 percent of calories) diet during the study. Cholesterol synthesis was determined after the oral administration of water containing heavy hydrogen (deuterium) by measuring its uptake in cholesterol from human milk as compared to that found in red blood cell membranes. Milk cholesterol levels were not

altered significantly by either diet, nor was total daily cholesterol secretions changed despite a significant decrease in total milk fat concentration when mothers ate a low-fat diet. A strong correlation was found between plasma cholesterol levels and the cholesterol concentration of early morning (fasting) milk samples. Cholesterol synthesis by the mammary gland accounted for 7.1 percent and 17.9 percent of total cholesterol found in milk; the remainder was derived from plasma lipoproteins. Milk cholesterol homeostasis was not altered by diet despite large changes in maternal cholesterol synthesis on different diets. Thus, it appears that the mammary gland will defend cholesterol secretion in milk to preserve lipid secretion during periods of restricted fat intake.

#### 4. Adult Nutrition

##### o Measurement of Ascorbic Acid Status in Humans

Better methods are needed to assess human vitamin C status in order to relate dietary vitamin C intakes to proposed health benefits and for monitoring the vitamin C status of the U.S. population. Various methods for assessing vitamin C status were studied in a highly controlled experiment in which healthy men received low, normal, and high intakes of the vitamin over 14 weeks, with depletion and repletion periods, living in a controlled metabolic unit. Vitamin C levels in blood plasma and white cells were found to be the best indicators of status. The plasma test is recommended for surveys because it is simpler to do and easier to interpret. Analysis of cheek mucosal cells (obtained from simply brushing the insides of the cheeks) suggests that this technique might be useful as a noninvasive test for screening populations for vitamin C deficiency. Vitamin C levels of infection-fighting white blood cells (lymphocytes) were the same whether subjects consumed normal or high intakes of the vitamin, indicating that no benefit for this function was derived from intakes of vitamin C above the recommended dietary allowance of 60 milligrams/day.

##### o Intakes of Selenium in Seleniferous Area and Health Implications

Increased dietary intakes of selenium are being advocated by some nutritionists as a way to protect against certain degenerative human diseases such as cancer and cardiovascular disease. In some cases, these dietary "recommendations" exceed the newly established Recommended Dietary Allowance for selenium as much as tenfold, thus raising the possibility of harmful overexposure to this nutritionally essential trace element. Unfortunately, the dietary intake that will cause toxicity in humans is not known with precision. Accordingly, a study was conducted in an area of South Dakota where the people are naturally exposed to high levels of selenium in their diet because of the high selenium content of soils. Over a 2-year period, 142 subjects were recruited from households selected at random, and from ranches where unusually high selenium intakes were suspected. Subjects completed health questionnaires; underwent physical examinations; provided blood samples for clinical assessment; and provided blood, urine, toenails, and duplicate-plate food collections for selenium analysis. About half of the 142 free-living subjects were found to have selenium intakes above 200 micrograms/day (range 68 to 724 micrograms/day). Physical findings characteristic of selenium toxicity were not present, nor were clinically significant changes in laboratory tests or frequency of symptoms related to



level of selenium in the blood, nails, or diet. No evidence of toxicity from selenium was found in subjects whose intake was as high as 724 micrograms/d. It would appear, therefore, that up to 400 micrograms/day of selenium from natural sources may be safely ingested by healthy adult males and nonpregnant females.

o Brain Wave Changes During Short-Term Vitamin B6 Depletion in Young Women

Low dietary vitamin B6 intakes have been found to be prevalent among American women. However, uncertainty has existed as to whether American women are receiving inadequate dietary vitamin B6, or if the standard used for comparison is too high. As part of a larger investigation to determine the vitamin B6 requirement of young women, clinical and biochemical changes reflective of vitamin B6 inadequacy were monitored. Tests to evaluate changes in dental tissues and the nervous system, as well as biochemical measures of vitamin B6 in the blood and urine were conducted on eight non-pregnant women fed a formula diet nearly devoid of vitamin B6. Within 12 days on the formula diet, two of the eight women exhibited abnormal brain wave tracings (electroencephalographic, or EEG, tracings). These changes were readily returned to normal by feeding the women a diet containing 0.5 mg of vitamin B6 per day. Although biochemical measures reflected lowered vitamin B6 body stores, they were not predictive of the onset of EEG changes. Knowledge of the relationship of clinical and biochemical changes accompanying insufficient dietary vitamin B6 are essential to establishing the vitamin B6 requirement for humans.

o Dietary History Comparisons of African-Americans, Native Americans, and European-Americans

Two hundred ninety-one adults (146 African-Americans, 56 Native Americans, and 89 European-Americans) residing in a county in North Carolina responded to an "Eating Habits Questionnaire." This contained questions on the eating frequency and serving size of 111 food and beverage items. A computerized program developed by the National Cancer Institute was used to compute estimates of daily energy and nutrient intakes from serving size and eating frequency information. Estimated energy intake of all women averaged about 62 percent of that for men. Calcium was the nutrient most likely to be consumed in amounts less than the recommended dietary allowances (RDA). African-Americans respondents tended to consume less calcium than did the Native Americans or European-Americans. Women of all three racial groups consumed about 75 percent of the RDA for iron, but iron consumed by men met the recommended allowances. Although estimates of energy intake were not high, 2,800 kcal for men and 1,800 kcal for women, about 15 percent of the men and 40 percent of the women could be classified as obese. Overall, about 45 percent of the energy intake was estimated to be derived from fat, and cholesterol intakes averaged greater than 300 mg for African-Americans and European-Americans but not Native Americans. It is recognized that good health does not require that everyone consume at least 100 percent of the RDA for the established nutrients. Nevertheless, indications are that nutrition counseling in such a community would be beneficial.



#### o Effects of Collegiate Sports on Body Composition

Members of collegiate basketball, football, swim, and wrestling teams were measured before and at the ends of their competitive seasons to determine whether their body compositions changed as a result of having participated in their sport season. Preseason measurements of body weight and estimates of fat weight and fat-free weight from underwater weighting were compared to end-of-season determinations; each team's season was 12 weeks long. No measurable changes in body composition were observed in football players. Basketball players and swimmers lost significant amounts of fat weight and significantly gained fat-free weight, without significant changes in total body weight. Wrestlers lost significant amounts of total body weight and fat weight without significant changes in fat-free weight. The findings of this study suggest that it is possible to change body composition as the result of extensive exercise as occurs in certain college sports.

#### o Effect of Folic Acid Supplements on Zinc Balance in Humans

Zinc and folacin are both required for the survival and well-being of all animals. However, there is increasing evidence of interactions between these two nutrients. In a 12-week study, supplements of 400 or 800 micrograms of folic acid per day added to a diet adequate in both zinc and folacin had no significant effect on Zn balance in eight men. An 800-microgram daily folate supplement seemed to increase Zn absorption that was compensated by increased endogenous excretion. Mobilization of zinc from tissues during maximal exercise was impaired when folic acid supplements were given. The amount of zinc mobilized seemed to be inversely related to the amount of folate fed. These data indicate an impairment of zinc utilization when excess folic acid supplements are given.

#### o Dietary Zinc Deficiency in Men

Zinc is required for the development of human male sex organs and production and function of sperm cells. Consequently, a study was conducted to determine the effects of short-term zinc deficiency on sperm characteristics in human males. Eleven men were selected to live on a metabolic unit for 203 days. During that time, each volunteer was fed a diet low in zinc and given a tablet daily which contained a known amount of zinc. Every 35 days, the level of zinc in the tablet given daily was changed from 1, to 2, 3, or 4 mg in a random order. During the last 35 days, all volunteers received a tablet daily which contained 10 mg of zinc. At the end of each 35-day period, semen samples were collected and quickly transported to the laboratory for analysis. Compared to when they were taking 10 mg zinc tablets, volunteers taking 1 mg zinc tablets were found to have lower semen volumes and elevated concentrations of seminal iron, phosphorus, and magnesium. Also, total seminal calcium, magnesium, phosphorus, and zinc concentrations were decreased when 1 mg zinc per day was being consumed instead of 10 mg. Clinically, the loss of those minerals in seminal fluid seems important only in the case of zinc. The data suggest that male fertility may be altered during short periods of zinc deficiency.

#### o Protection From Malaria by Dietary Means

The leading infectious disease threatening humans today is malaria. About half the global population lives in areas, primarily developing nations, where the incidence of malaria is either at or reaching epidemic proportions. It has been found that the blood forms of the malarial parasite are highly susceptible to oxidant stress. Feeding the ethyl ester of the easily peroxidized highly unsaturated fatty acid, linolenic acid, to vitamin E-deficient mice confers protection against Plasmodium yoelii as judged by suppressed parasitemia and enhanced survival. Also, vitamin E-deficient diets containing 5 to 20 percent ground flaxseed were found to protect mice against the malarial parasite. Although the biochemical mechanism of this dietary effect is not established, it is presumed that the high content of linolenic acid in the flaxseed oil coupled with the oxidant stress generated by the parasite destabilizes the host red blood cell, leading to erythrocyte lysis and destruction of the parasite. Ground flaxseed may be a convenient vehicle for the introduction of peroxidizable fat into the human diet to prevent and/or cure malaria.

### 5. Elderly

#### o Vitamin B6 Requirements of the Elderly

The vitamin B6 requirements of elderly men and women (greater than 60 years) were studied using a depletion-repletion design. The protocol consisted of having subjects eat a diet deficient in vitamin B6 for 17-20 days and then feeding them diets containing increasing amounts of vitamin B6 over a period of 63 days. Biochemical tests for vitamin B6 status were done on blood and urine specimens collected during the period of vitamin B6-deficiency. The status gradually returned to normal during vitamin B6 repletion. The amounts of vitamin B6 that restored the biochemical tests to baseline (i.e., pre-depletion) values were considered the minimum vitamin B6 requirements. These were determined to be 1.96 mg/day for elderly men and 1.90 mg/day for elderly women. These values are greater than the minimum vitamin B6 requirements reported for younger adults.

#### o Vitamin B12 Absorption in Atrophic Gastritis

Poor absorption of food-bound vitamin B12 has been reported in atrophic gastritis, a common condition of aging which is characterized by reduced or no gastric acid output, as well as increased numbers of bacteria in the upper parts of the small intestine and the stomach. Food-bound vitamin B12 is poorly absorbed in atrophic gastritis subjects as compared to normal controls. It has been found that this poor absorption of vitamin B12 can be reversed by the administration of an antibiotic. These findings suggest that the increased numbers of bacteria in the upper parts of the stomach and small intestine cause the poor absorption of food-bound vitamin B12 by binding the vitamin and using it for their own purposes. The poor digestion of food protein from vitamin B12 due to lack of acid seems to play only a minor role in causing the vitamin B12 malabsorption in this condition. Reducing the number of bacteria in the stomach and the upper intestine normalizes the poor absorption of food-bound B12.



o Effect of Gastric Acidity and High Fiber Intake on Calcium Absorption in Elderly

Osteoporosis is a debilitating problem in the elderly that is associated with decreased absorption of calcium by the intestine. Some studies have suggested that inadequate amounts of gastric acid and diets high in fiber decrease calcium absorption. This is important because decreased production of gastric acid (achlorhydria) affects more than 24 percent of persons over age 60. Accordingly, the ability of the intestine to absorb calcium from test meals was measured in nine healthy elderly subjects and eight elderly subjects with achlorhydria. Healthy controls given a low-fiber meal (0.5 g) retained 26 percent of the calcium. A test meal high in fiber (10.5 g) reduced the amount of calcium absorbed to 20 percent. However, there was no difference in absorption of calcium between normal subjects or subjects with achlorhydria. Further, the addition of hydrochloric acid to the test meal to stimulate gastric acid did not change the absorption of calcium. This study shows that calcium is well absorbed from food and that its absorption does not depend on gastric acid. High fiber intake decreases the absorption of calcium. These data are important in determining calcium requirements in the elderly.

o Cataract Prevention--Degradation of Proteins in Cultured Bovine Lens

In order for the lens to maintain clarity and transmit light to the retina, proteins that are no longer necessary for the lens cell or that are damaged must be degraded. If damaged proteins are not removed, there is a high probability that lens clouding and cataract will occur. A study was done to determine if the lens contains the enzymes necessary to degrade various lens proteins. Three proteins were chosen: (1) alpha crystallin, the major lens protein; (2) histone H2A, a component of the DNA machinery for protein synthesis; and (3) actin, a protein necessary for the movement and structure of lens cells. It was found that 26 percent of the histone H2A was broken down by lens cell enzymes, but only 2.5 percent and 3.3 percent of the alpha crystallin and actin, respectively, were broken down. This suggests that histone H2A is processed by the lens when it becomes obsolete, but that alpha crystallin and actin are required for the normal functioning of the cell and are not broken down as readily. Cells that can be grown in the laboratory have also been prepared from bovine lenses. Degradation of protein in these cells is used as a model for protein degradation in the lens. It was found that protein degradation capability is dependent on calcium in these cultured bovine lens cells. A specific calcium-dependent enzyme (calpain) has been identified in these cells.

o Nutrient Intake and Senile Cataract

Relatively little is known about factors which modify senile cataract risk even though cataracts are an important cause of disability. Care of patients with cataracts costs billions of dollars annually. Evidence that nutrition plays a role in the development of senile cataracts in humans is limited, but available data suggest that higher intakes of vitamins C and E and carotenoids may reduce cataract risk. To examine the role of nutrition in cataract formation, food consumption and vitamin supplement use were assessed in 77 persons with senile cataracts and 35 persons with clear lenses. Subjects who reported consuming less than 250 g of folate per day were 6 times more likely to have cataracts than subjects who reported consuming more than

725 g per day. Subjects reporting vitamin C intakes below 125 mg per day were 4 times more likely to have cataracts than subjects with intakes greater than 490 mg per day. Persons consuming 3.5 or fewer servings of fruits and vegetables per day were almost 5 times more likely to have cataracts than persons consuming more than 8.5 servings per day. Although these results are preliminary, they support existing evidence of a relationship between vitamin C and cataracts and indicate that further examination of the previously reported relationship between folate and cataracts is warranted.

o Exercise-Induced Muscle Damage in Older Men

Eccentric exercise resists force and absorbs the mechanical energy imposed by the environment. Walking downhill, lowering a weight, and lowering oneself into a chair are examples of eccentric exercise. Eccentric exercise is a component of all physical activity. It has been found that eccentric exercise results in muscle damage which can last for an extended period of time. Prior USDA research shows that in young men who perform similar exercise, approximately 5 percent of the muscle fiber shows evidence of damage. Although delayed soreness and stiffness may result, the muscle damage is repaired without any residual dysfunction or scarring. This study was to examine the effects of eccentric exercise on skeletal muscle structure, using electron microscopy in men 59-63 years of age performing a similar amount of eccentric exercise. Almost 50 percent of the fibers examined in these older men showed evidence of damage after the exercise. Perhaps older people are more susceptible to exercise-induced muscle damage than young people because the elderly have lower muscle mass or lower fitness levels, or they may have some pre-existing muscle damage. This finding indicates that care should be taken in elderly subjects when beginning a program of increased physical activity. They should begin training slowly and avoid high-intensity exercise until they have adapted to the exercise.

o Strength Training in Nonagenarians

Muscle weakness is very common in the frail elderly. This weakness and reduced mobility greatly increase the risk of falls and fractures. In a previous study, it was demonstrated that 12 weeks of weight lifting caused large increases in muscle strength and size in men aged 60 to 72 years. In this study, the ability of frail nursing home patients to respond to 8 weeks of weight lifting exercise was examined. Dietary intakes were recorded. The subjects were 10 patients of the Hebrew Rehabilitation Center for the Aged, Boston, MA, ranging from 87 to 96 years of age. They were trained at 80 percent of the maximum lifting capacity for 3 days each week. At the start of the study, muscle strength was significantly reduced to walking speed. Most of the group did not obtain the RDA for some micronutrients from their diet. Despite this, the training program increased muscle strength by 174 percent and thigh muscle area strength increased almost 10 percent. It is concluded that strength training is feasible even in the frail elderly, leading to gains clinically relevant in muscle strength and physical performance.

o Nutritional Status of Elderly Smokers and Nonsmokers

Previous studies have suggested that smokers may have lower blood nutrient levels than nonsmokers due to some element in cigarette smoke which affects nutrient absorption or metabolism. In this study, both the diets and blood



nutrient levels of 87 elderly smokers and 637 nonsmokers were examined. Differences in the nutritional status of the two groups were observed which were consistent with earlier research. Smokers' intakes of all nutrients except for vitamin B12 and folate were significantly lower than nonsmokers' intakes, after adjustment for age, sex, and total caloric intake. Lower blood levels of carotenoids, retinol, riboflavin, vitamin C, and magnesium and higher levels of calcium were seen in smokers compared to nonsmokers, after adjustment for age and sex. Differences in carotenoid and riboflavin levels persisted after adjustment for intakes of these nutrients. The majority of the differences in blood nutrient levels observed between smokers and nonsmokers can be explained by the poorer quality of the smokers' diets. It is likely that the small differences in intake which were observed would assume added importance in a population of elderly with marginal or inadequate nutritional status.

## 6. Nutrient Function

### o Dietary Boron and Brain Function

A previous study related dietary boron to brain function in healthy adults. Under resting conditions, the electroencephalogram showed changes in the brain's electrical activity in response to varying boron intake. Lower boron intakes resulted in a pattern of activity typically associated with reduced arousal and decreased mental alertness. However, participants in that study were also fed a diet low in magnesium throughout, and there were no controls for possible time effects. The present study, conducted with mature rats, examined the effects of boron intakes on brain electrical activity, but controlled for the effects of dietary magnesium and time. Diets low in boron and/or magnesium were fed for nearly 3 months. When compared to rats fed an adequate amount of boron (3 ppm), rats deprived of boron showed decreased electrical activity on both the left and right side of the brain and a shift in the pattern of electrical activity, consistent with that observed in the human study. Dietary magnesium had no significant effects on brain function. These observations validate the earlier findings with humans and suggest that the nutrient boron may play an important role in maintaining normal brain function.

### o Silicon Enhances Bone Mineralization on Low-Calcium Diets

It is not known if the mineral element silicon is important in human nutrition. However, silicon deprivation changes found in animal models have led to the speculation that the lack of dietary silicon may be involved in certain human disorders, including the bone disorders of osteoarthritis and osteoporosis. It has been shown that silicon deficiency depresses the ash content of bone, but there is no evidence that there is an effect on bone mineral composition. Thus, an experiment was performed with rats fed with and without silicon in a low-calcium diet. Silicon deprivation of these rats depressed the bone concentrations of calcium, phosphorus, and magnesium of skull and tibia, as compared with controls fed silicon. This finding indicates that, in rats fed a low-calcium diet, silicon enhances the incorporation into bone of elements that are major components of the mineral fraction and support the concept that silicon is involved in the growth and maintenance of healthy bones.

#### o Magnesium Deprivation in Postmenopausal Women

Because magnesium is crucial in more than 300 chemical reactions in the body, the dietary lack of it has been suggested as contributing to the cause of several human disorders, including ischemic heart disease, osteoporosis, and pregnancy complications. Although magnesium deficiency can be induced with relative ease in young experimental animals, deficiency has been found difficult to induce in humans. In fact, efforts to produce signs of magnesium deficiency in humans simply by restricting dietary intake have generally been unsuccessful. Thus, two experiments were performed with healthy postmenopausal women, since women at this stage are thought to have an increased need for magnesium. In both experiments, magnesium deprivation, or 109-115 mg/2,000 kcal, depressed plasma cholesterol and changed red blood cells in a manner which suggests an alteration in their membranes. The findings indicate that significant effects do occur from low dietary intakes of magnesium in healthy adults. Some women after 52 and 64 days on the low-magnesium diet showed heart rhythm abnormalities suspected to be caused by the low magnesium intake. In one experiment, a significant elevation in mean corpuscular volume and hemoglobin concentration was also observed with magnesium deprivation. These experiments help to define the importance of magnesium in human nutrition.

#### o Free Radicals Production in Copper Deficiency

Free radicals are highly reactive chemical species, most often derived from oxygen, and are products of normal metabolism. When formed and allowed to react unchecked they can damage proteins and lipids and affect the functions which depend on those molecules. In the normal individual, enzymes and other chemicals inactivate these free radicals. Because the activities of some of those antioxidant enzymes are reduced by dietary copper deficiency, one hypothesis is that the adverse effects of copper deficiency may be caused by free radical damage. A method of assessing damage by free radicals is to measure the production of ethane, a product of the reaction between free radicals and certain types of lipids. Since ethane is volatile, it is released from the blood into the lungs and is readily measured in the breath of living animals. Accordingly, the breath ethane production in copper-deficient and control rats was measured and found to be higher in copper-deficient animals. This finding supports the hypothesis that free radical damage occurs in the living animal in a copper deficiency.

#### o Dietary Linolenic Acid Effects on Immunocompetence

Typical American diet contains less than 0.3 percent calories from the n-3 (omega-3) fatty acids. Some groups have advocated that higher levels of these fatty acids should be consumed to lower the risk of cardiovascular diseases. The effect on the indices of immune status of adding 6 percent of the calories from flaxseed oil (rich in alpha-linolenic acid, an 18 C n-3 fatty acid) to the diet of 10 healthy young men for 56 days was determined with a switchover experimental design to a control diet. Feeding the diet containing the added linolenic acid suppressed three indicators of cell-mediated immunity, including suppression of peripheral blood lymphocytes in response to mutagens, as compared to the corresponding indices in the men fed the basal diet. No health risk was noted from the feeding of the flax diet, but suppression of



immunity for a prolonged period of time may not be desirable in healthy men. However, if such suppressive effects can be attained in individuals with chronic inflammations and autoimmune diseases, such diets may be useful in the management of diseases like arthritis, lupus, and allergies. Before recommendations can be made, however, information is needed as to the safety and other specific effects of such diets.

#### o Copper Status and Immune Response

It was found recently that the function of rat macrophages was impaired by marginal, as well as severe, dietary copper deficiency. Macrophages are a defensive type of cell in the immune network that helps in the destruction of organisms and repairs damaged tissue. This finding suggested that an inadequate copper intake may jeopardize the integrity of the immune system, thereby increasing susceptibility to infection. Moreover, the results suggested that function of phagocytic cells might provide a sensitive tool for assessing copper status. Because neutrophils, rather than macrophages, are the most common type of white blood cells in humans and many domestic animals, this hypothesis was tested using rat neutrophils. The data clearly show that the levels of cellular copper, the activity of superoxide dismutase, an intracellular enzyme, responsiveness to stimulatory agents, and the ability to kill yeasts in culture were all decreased in neutrophils from copper-deficient rats. Moreover, survival of yeasts injected into copper-deficient rats exceeded that of yeasts injected into control rats. Impairment of neutrophil function was found to be a more sensitive indicator of copper status than the parameters currently employed. Moreover, depressed neutrophil function, due to inadequate intake of copper, occurred rapidly and was readily repaired by copper supplementation. These data support the hypothesis that neutrophil function can be monitored to assess copper status.

#### o Cognition-Psychomotor Assessment System

A computer software package, the Cognition-Psychomotor Assessment System, has been developed to automate the administration and scoring of over 20 tasks designed to assess psychological function in studies of nutrition. Tasks were adapted from neuropsychology and experimental cognitive psychology to permit assessment of attention, perception, learning, memory, and problem-solving processes, as well as sensory-motor and spatial skills. Scientists can evaluate performance, on a battery of tasks they select, in relation to nutritional status, or in response to dietary manipulations. This package of programs can be run on a microcomputer, providing the researcher access to a broad range of tasks, at far less cost than supplies and equipment necessary for manual administration and scoring. The system is menu-driven and provides help screens to facilitate use by novice and expert alike. In addition, utilities have been included for transfer of performance data to mainframe computers for analysis with commercial statistical packages. The system has been successfully applied to the study of nutritional effects on psychological function in adults.

## C. Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders

### 1. Body Composition

#### o Comparison of Very-Low Calorie Foods vs. Formula Reducing Diets in Women

Very low-calorie diets, generally less than 600 calories/day, have become popular when large amounts of weight loss are desired. However, information regarding the effects of these low-calorie diets on body composition and physical performance is limited. Therefore, a study was conducted with 21 obese women, fed either a meat/fish/poultry (MFP) low-calorie diet (450-600 cal/d) or to a liquid formula (OPTI) diet (450 cal/day). Body composition and physical performance were assessed by standard underwater weighing and cycle ergometry procedures. Weight loss was similar for both groups: 24.5 kg for MFP and 26.7 kg for OPTI. Likewise, lean body mass (fat-free mass) losses were about the same: 4.0 kg for MFP and 5.4 kg for OPTI. However, the group fed the liquid diet showed a marked decline in physical performance after dieting while the women fed the meat-fish-poultry diet did not.

#### o Trace Element Balance During Weight Reduction

Low-energy diets used for weight reduction may cause a loss of mineral elements as adipose and muscle tissues are broken down. This was assessed by determining mineral balance in adults or the difference between the amount of minerals consumed in the diet and that excreted in stools and urine. Thirteen young adult men consumed nutritious, low- and high-energy diets containing 25 and 45 kcal/kg body weight (approximately 11 and 20 kcal per pound), respectively, for 4 weeks each. The men lost an average of 4.7 kg (10 pounds) during the low-energy diet and gained 0.9 kg (2 pounds) during the high-energy diet. There was little or no measurable difference in retention of calcium, magnesium, and manganese in subjects eating the two diets over this period. However, the men retained substantially less copper, iron, and zinc when fed the low-energy diet despite a generous supply of these minerals. The findings suggest that copper, iron, and zinc are the minerals of greatest concern for persons on weight loss programs.

#### o Reference Man and Woman More Fully Characterized

Several methods exist to describe and analyze the various components of matter in living human beings. Total body neutron activation analysis, prompt-gamma neutron activation analysis, and whole body counting have been used in an adult U.S. population to determine the elemental composition of the human body. The elements measured were potassium, nitrogen, calcium, chlorine, and phosphorus. Total body water was determined by the dilution principle using stable isotope labeled water (tritiated). A total of 1,374 observations were made in adults ranging in age from 20 to 90 years. Age-, race-, sex-, and size-specific differences were evident. When equations were developed that predicted the elemental composition of the adult on the basis of age, weight, and height, variation in the age groups was up to 10 percent. Age-specific values for the 20- to 29-year-old white population were also compared with values for the International Commission on Radiological Protection Reference Man. The "average" young adult U.S. male is larger than Reference Man; the



data also indicated a larger skeletal mass and more lean tissue and body water but less body sodium. However, when the in vivo prediction equations were used to adjust for size differences, good agreement was found between the expected values and for Reference Man. These data provide the first estimates of body composition for Reference Woman. These techniques can also be used to examine the effects of diet, growth, aging, or malnutrition in living infants and children.

o Estimation of Total Body Water in African-Americans

Bioelectric impedance analysis (BIA) is one of the newer methods used to assess body composition by clinicians, by national surveys teams, and by the Department of Defense. Bioelectric impedance analysis methodology has been developed largely using equations and data collected in European-American populations. Since several differences are known to exist between the body composition of African and European Americans, a study was designed to investigate the applicability of bioelectric impedance analysis in African-Americans, using prediction equations developed from European-Americans. A multiple regression equation developed with data from 79 European-Americans, using deuterium oxide dilution as the reference method, was applied to 88 African-Americans aged 19-50 years. There was good correlation between total body water estimates predicted by bioelectric impedance analysis with that determined using deuterium oxide ( $r = 0.98$ ). It is concluded that bioelectric impedance analysis may be valuable in the assessment of body composition in African-Americans, although total body water was slightly underestimated using equations from European-Americans. This may be due to racial differences in body composition; hence race-specific equations were developed. These equations will be useful in further studies by other scientists or agencies.

o Body Composition Assessment Using Total Body Electrical Conductivity (TOBEC)

In recent years, researchers have shown a strong relationship between body fat and diseases like coronary heart disease, hypertension, and diabetes. One concern, then, is the accurate assessment of body composition. Therefore, a study was conducted to define the accuracy of estimates of body composition, obtained with a total body electrical conductivity (TOBEC) instrument, for the general population. The TOBEC approach is used to measure lean body mass with body fat calculated as the difference between body weight and lean mass. Males and females (N=349) between the ages of 11 and 90 years served as research volunteers. Lean body mass was assessed by underwater weighing procedures, and body conductivity was measured by the TOBEC instrument. The results from this project demonstrated highly significant relationships between the TOBEC conductivity coefficients and lean body mass across all groups. Conductivity coefficients generated by the TOBEC instrument were used to develop prediction equations for lean body mass for the total sample, specific age groups, and obese individuals. These equations gave results similar to those obtained by the underwater weighting procedure for all age groups. The rapidity, noninvasiveness, and accuracy of the TOBEC procedure make it a valuable tool for body composition assessment of the general population.

## o Measuring Body Fat: Intermethod Comparisons in Human Subjects

New methods in body composition research provide new opportunities: construction of multicompartiment models for all components of body weight; definition of the limits of "consistency" assumptions for density, potassium, and water contents in the lean body; and improved accuracy in measuring the major compartments of bone, muscle, and fat. Measurements were made in 338 normal European-American subjects of body water, underwater weighing, body potassium, and anthropometrics; and the newer methods of dual photon absorptiometry, bioimpedance analysis, and carbon and nitrogen by in vivo neutron activation analysis. Body fat by all methods shows high correlation, with group means ranging from 26 to 35 percent of body weight. Intermethod comparison equations in the form of linear regressions for each sex were formulated to describe the direct inter-relationships among the eight methods. Multiple regression analysis using age, height, weight, and skinfold thickness narrowed the standard error to about  $\pm 3$  percent.

## o Branched Chain Amino Acids Oxidized by Skeletal Muscle

Previous work has shown that oxidation of the branched-chain amino acids is increased during aerobic exercise. Thus one could hypothesize that endurance exercise could alter the dietary requirement for essential branched-chain amino acids. Adaptive effects of exercise training on the oxidation of the branched-chain amino acid leucine and branched-chain keto acid dehydrogenase activities in muscle and liver were investigated. Rats were trained to run on a motor-driven treadmill for 20 weeks or were left sedentary. Exercised animals oxidized significantly more leucine than sedentary controls; this effect was much larger in the untrained animals. A bout of exercise increased the proportion of branched-chain keto acid dehydrogenase in the active state in muscle and liver of untrained rats but not in trained rats. Training resulted in a twofold increase in total muscle branched-chain keto acid dehydrogenase activity and a 33 percent increase in total liver branched-chain keto acid dehydrogenase activity, while a single exercise bout did not affect total activities. These data demonstrate that leucine oxidation is stimulated by a bout of exercise and that the stimulation is proportional to the duration of the bout.

## 2. Dietary Lipids

### Inhibitory Potencies of Fish Oil on Platelet Aggregation

Dietary supplementation with fish oils has been suggested as a possible approach to prevent cardiovascular disease. Fish oils contain appreciable amounts of two polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These two fatty acids can be converted in the body to more oxidized forms called hydroxy fatty acids, which may interfere with the production and subsequent actions of the lipidlike hormones known as prostaglandins. The effects of the hydroxy acids on platelet clotting and on enzymes (catalysts) that form prostaglandins were studied. Platelets from animals fed either a corn oil diet or a fish oil diet for 1 week were isolated and induced to clot in the presence of the various hydroxy acids. To varying degrees, the hydroxy acids inhibited the ability of the platelets to clot and produce prostaglandins. The hydroxy acids from EPA were not as effective in inhibiting platelet responses as those from DHA. Activities of the enzymes



that produce prostaglandins were not different between platelets from the fish oil and control dietary groups. These results confirm a possible modulatory role for certain hydroxy acids from marine oils in controlling platelet function and prostaglandins synthesis. Knowledge of amount and type of fatty acid to be included in the diet for optimum health is still lacking.

o Effects of a Salmon Diet in Humans

Purified fish oils, containing omega-3 fatty acids, when taken as a dietary supplement, decrease blood clotting and influence platelet functions in people and may help to protect against heart disease. Whether the same physiological effects can be obtained from the consumption of fresh fish is unclear. In this study, healthy male volunteers, living in a nutrition unit, consumed a diet containing a pound of salmon per day for 40 days after being on a stabilization diet (no omega-3 fatty acids) for at least 20 days. Blood samples were drawn before and after the salmon diet, and blood clotting values and the fatty acid composition of their plasma, red cells, and platelets were determined. There was no difference in the blood clotting times before and after the salmon diet. There were, however, subtle changes in platelet function and a significant decrease in the platelet counts in the volunteers consuming salmon. The fatty acids in the plasma, red cells, and platelets showed major increases in their omega-3 content. It was found that changes previously reported in people consuming fish oil supplements can be duplicated by consuming fresh fish. Thus, a diet containing fresh fish may provide health benefits.

o Long-Term Fish Oil Supplementation and Vitamin E Status of Women

With the renewed interest in fish oil for the prevention of disease, potentially harmful effects of fish oil products have been overlooked. The effect of fish oil supplementation was investigated in 15 young and 10 older women using 6 capsules/day (concentrated fish oil containing 400 mg omega-3 fatty acids and 1 IU of vitamin E per capsule) for 3 months. It was found that plasma triglyceride level was significantly reduced in both groups with fish oil supplementation. This reduction was concomitant with a significant increase in plasma omega-3 fatty acids. However, the plasma level of lipid peroxides was increased significantly despite the increase in plasma-vitamin-E-to-triglyceride ratio. This was most pronounced in older women. Lipid peroxides are toxic substances and are oxidative products of omega-3 as well as other polyunsaturated fatty acids (PUFA). The level of these products may increase when the level of vitamin E relative to PUFA decreases or when other oxidative stresses are introduced. The results indicate that long-term intake of fish oil capsules increases lipid peroxide levels in the bodies of both younger and older subjects. The data suggest that it may be necessary to increase vitamin E content of fish oil capsules or, alternatively, the users of fish oil capsules should increase their vitamin E intake.

o Dietary Fat- and Cholesterol-Induced Lipoprotein Changes in Minipigs

Feeding studies with minipigs, used as models for humans, showed drastic changes in the physical chemical properties of the very low-density

lipoproteins. One of the lipoproteins, responsible for transporting fat in the circulation, became more rigid after short periods of cholesterol feeding. Conversely, replacement of a high-fat, high-cholesterol diet with a low-fat, cholesterol-free diet rapidly reduced lipoprotein rigidity. The increased rigidity observed in the lipoprotein was followed by development of engorged fatty cells, known as "foam cells," in the walls of the arteries. Such cellular changes are usually followed by atherosclerosis. The findings of this research will help scientists understand the chemical events relating diet and atherosclerosis.

o Preparation of Labeled Omega-3 Fatty Acids

The recent interest in fish oil supplements has led to investigation of the roles of omega-3 and omega-6 fatty acids in the human diet. The study of the metabolism of fats in humans requires compounds that are not radioactive, yet are "labeled." Two omega-3 fatty acids, labeled with the stable isotope deuterium, have been prepared in quantities suitable for study of their metabolism in humans. These compounds are methyl 11,14,17-eicosatrienoate-8,8,9,9-D<sub>4</sub> and methyl 8,11,14,17-eicosatetraenoate-8,9-D<sub>2</sub>.

o Omega-6 Dietary Fatty Acid and Plasma HDL Lipoprotein

Solution of dietary problems associated with cardiovascular disease (CVD) requires that plasma cholesterol levels be lowered. However, an inherent problem in conducting studies using natural food diets is that when the total amount of fat is reduced, more than one fatty acid class (saturated, monounsaturated, or polyunsaturated) is changed. To avoid this problem, two diets were devised which allowed for the modification of only one fatty acid class. Using this technique, in a study involving 11 healthy middle aged men, reductions in total cholesterol, LDL-cholesterol, and apolipoprotein B-100 and an increase in apolipoprotein A-1, were achieved by increasing only the intake of linoleic acid, an omega-6 polyunsaturated fatty acid. The most interesting finding was that HDL-cholesterol did not decrease when the higher level of linoleic acid was fed. This is in contrast to findings in previous studies, reporting that high omega-6 PUFA diets lowered plasma HDL-cholesterol. This is important because high levels of omega-6 fatty acids in the diet have been thought to lower serum HDL-cholesterol and in turn increase the risk of coronary heart disease.

o Familial Lipoprotein Disorders in Patients with Coronary Disease

Genetic lipid disorders were examined in 102 families of patients with heart disease. Cholesterol lipoprotein levels and apolipoprotein levels were determined on the patient and family members. Half of the patients had a genetic form of lipid disorder, most frequently Lp(a) excess (a genetic condition predisposing to heart disease but not affected by diet), and disorders associated with low HDL cholesterol. It was concluded that these genetic lipoprotein disorders are common in subjects with premature coronary artery disease and such patients, as well as their children, should be checked for such genetic disorders.



o Dietary Fat Influenced Fecal Mutagenicity in Women

Cancer of the colon is a major cause of cancer deaths in this country, accounting for about 90,000 deaths/year. To a large extent, diet and lifestyle have been implicated as contributing to this high mortality. In a search for possible nutritional factors, the observation that high-risk populations (as in the United States and in Europe) generally consumed a diet rich in fat, providing about 40 percent of the total calories consumed, was taken into account. The very natural question was if dietary fat is implicated in cancer risk, what type of biological markers can we use to correlate cancer risk with fat intake. Since an assay for fecal mutagenicity as a risk assessment marker had been developed at the Beltsville Human Nutrition Research Center, this technique was used in a study, where 31 premenopausal women were initially fed a diet containing 40 percent calories from fat, and then transferred to a diet containing 20 percent calories from fat. It was found that when dietary fat was decreased, there was a significant drop in the mutagenicity of the stools. This finding is consistent with the hypothesis that risk of colon cancer is greater in populations that consume a higher proportion of their energy as fat.

o Vitamin E and Endothelial Permeability of Lipoproteins

Age is strongly correlated to the onset of atherosclerotic lesion formation in humans. This may be associated with an age-related increase in the susceptibility of the vascular endothelium to oxidative injury. Such injury may result in altered endothelial function as a barrier to plasma components, such as cholesterol-rich lipoprotein remnants. To investigate this hypothesis, the relationship between endothelial cell culture age, susceptibility to oxidative injury and protection against this injury by the antioxidant vitamin E on endothelial barrier function (transfer of albumin across endothelium) was examined. An acute 24-h exposure to linoleic acid hydroperoxide resulted in increased albumin transfer at all cell passages tested. Enrichment of cells with vitamin E prior to exposure always protected endothelial cells against oxidized fatty acid-induced cell injury, independent of cell age.

o Effects of Dietary Fats on Blood Cholesterol

Investigations were conducted to clarify the role of several different dietary fats on the coronary heart disease risk factor, serum cholesterol. Dietary fat digestibility was also quantified. Eighteen normocholesterolemic healthy male subjects (ages 23-35) each consumed whole-food diets high in cocoa butter, butter, olive oil, and soybean oil for 25 days followed by a 1-month washout period. Experimental diets contained 400 mg of cholesterol daily and contributed 38 percent of calories from fat of which 82 percent was provided by the test fat. Total plasma and low density lipoprotein cholesterol were unchanged after subjects consumed the cocoa butter diet. Both lipids were significantly higher in subjects on the butter diet and lower on the olive oil and soybean oil diets. Digestibility of dietary lipid was significantly lower on the cocoa butter diet (94 percent) versus the olive oil (96 percent), soybean oil (97 percent), and butter (96 percent) diets.

### 3. Dietary Fiber and Carbohydrates

#### o Effects of Rice, Oat, and Wheat Bran on Serum Lipids

Health-related concerns of consumers prompted research to investigate the cholesterol-lowering potential of several sources of cereal brans. This study showed that rice bran (full-fat), stabilized or parboiled, and oat bran, fed at levels to provide 10 percent dietary fiber, resulted in significant plasma cholesterol reductions as compared with control hamsters fed a similar level of cholesterol (0.5 percent) and 10 percent cellulose. A combination of rice bran/wheat bran (5/1) was also effective in lowering elevated cholesterol levels. However, removing the fat from rice bran resulted in a loss of its cholesterol-lowering properties. These data suggest that a fat component of rice bran has the promising potential of lowering blood cholesterol in hypercholesterolemic animals and possibly in humans.

#### o Effect of Dietary Carbohydrates in Obese Rats

Since opiates and neuropeptides are believed to be involved in glucose regulation, their effect in obese diabetic rats was studied. Obese rats had significantly higher levels of B-endorphin and lower levels of leu- and met-enkephalin in plasma. Dietary sucrose, compared to starch, magnified the differences. When brain membranes from these rats were studied for opiate receptors, less binding of opiate agonist atrophine was found in obese rats as compared to lean rats. No difference in naloxone binding was observed. Feeding complex carbohydrates (starch) as compared to sucrose was also observed to result in fewer and smaller body fat cells and to delay the development of kidney disease. These data show that beside pancreatic hormones, opiates are also involved in glucose regulation.

#### o Low Dietary Copper, Fructose, and Metabolic Changes in Pigs

Human and animal nutrition studies indicate that the amount of dietary copper needed to sustain optimal health varies with the type of carbohydrate consumed. When fructose was fed to humans as 20 percent of calories, a number of risk factors associated with heart disease were increased. These effects did not occur when cornstarch replaced the fructose. Male rats fed a copper-deficient diet, with 63 percent of calories as fructose or sucrose, die from heart problems within 7 or 8 weeks, while rats fed cornstarch or glucose survive. Since pigs have a circulatory system that is very similar to that of humans, they were used in a 10-week experiment to study the relationship between carbohydrates and copper. After 10 weeks, pigs fed a low-copper, 20 percent-fructose diet were anemic, had enlarged livers, and had hearts twice as big as those of copper-deficient pigs fed 20 percent glucose. Certain enzymes that require copper (plasma ceruloplasmin, erythrocyte superoxide dismutase, and lysyl oxidase) were found to be adversely affected. The results confirm previous studies in which fructose appeared to cause unhealthy changes in an animal's circulatory system when low-copper diets were fed. The results also suggest that pigs may be a good experimental model for this type of research.



- o Cholesterol-Lowering Properties of Oats, Barley, and Wheat Fractions in Chicks and Rats

The cholesterol-lowering effect of oats, barley, and wheat has been the subject of much recent research. A cooperative study was conducted in which oat bran and milled fractions of two waxy, hull-less barley cultivars were compared with wheat bran for their cholesterol-lowering effects. Products were tested in chicks (Montana State University) and in rats (Kansas State University). In both species, oat bran and one of the barley cultivars demonstrated a significant lowering effect on total and LDL-cholesterol levels, while HDL-cholesterol was not lowered. Wheat bran had no cholesterol-lowering effect. Barley milling fractions offer a high-fiber, cholesterol-lowering alternative to oat bran.

#### 4. Bone Density and Osteoporosis

- o Calcium Supplements and Bone Loss in Postmenopausal Women

Gradual loss of bone minerals results in the development of spontaneous fractures or osteoporosis in a large proportion of elderly women. Despite extensive investigation, there is no consensus on whether increased calcium intake will reduce bone loss. Results of a pilot study conducted at the Human Nutrition Research Center on Aging suggested that, of women beyond the menopause, those most likely to benefit from calcium are the ones with low dietary intakes of calcium. Therefore, the effect of calcium supplementation was examined in this population, in a large controlled trial. Women within 5 years of menopause (perimenopausal) did not benefit from supplementation with calcium. In contrast, women beyond the perimenopausal period (postmenopausal) with low calcium intakes had reduced bone loss from the spine, hip, and radius when calcium supplements were given. This is the first demonstration in a controlled study that added calcium reduces bone loss from the spine and hip. On the basis of this study, it is recommended that postmenopausal women be urged to increase their calcium intake to approximately 800 mg daily.

- o Effects of Increased Dietary Calcium and Exercise on Bone Calcium in Postmenopausal Women

Physical activity has been shown to affect the rate of bone loss in postmenopausal women. To date, there have been no studies that have evaluated the interaction between increased levels of physical activity and increased dietary calcium. This study examined the effects of a 1-year (4 days per week, 50 minutes per day) supervised walking program and increased dietary calcium on bone health (measured by examining the bone density of the spine, hip, and radius as well as the total amount of calcium in the body) in postmenopausal women. Four groups of women were followed: (1) women who remained sedentary and did not change their calcium intake, (2) sedentary women who increased their calcium intake by 831 mg/day, (3) walking women with no change in calcium intake, and (4) walking women who increased their calcium intake by 831 mg/day. No interaction between exercise and calcium intake was found. However, the femoral neck (in the hip) increased by 1.9 percent in the women eating the high-calcium diet and decreased by 1.5 percent in those on moderate calcium intake. The exercise caused a 1.2 percent increase in the density of the lower spine while the sedentary women showed a 6.0 percent

decrease. The data indicate that both increased dietary calcium and exercise have positive but different effects on the bone health of postmenopausal women.

o Regulation of Active Form of Vitamin D in Women

Poor absorption of calcium is thought to contribute to the problems of bone loss and osteoporosis in the elderly. The biologically active form of vitamin D, 1,25-dihydroxyvitamin D, is important because it stimulates the intestinal absorption of calcium. This compound is formed from vitamin D in a reaction that is influenced by the serum concentrations of phosphorus and parathyroid hormone. In this investigation of 275 healthy postmenopausal women, it was found that the serum calcium concentration also directly influences the serum level of 1,25-dihydroxyvitamin D. A low serum calcium increases and a high calcium decreases the level of the active form of vitamin D in the blood. Understanding of the regulation of 1, 25-dihydroxyvitamin D is a requisite for developing strategies to enhance calcium absorption in the elderly.

o Smoking and Bone Loss Among Postmenopausal Women

Women who smoke are known to have lower bone density than those who don't smoke. It is generally thought that smoking lowers the peak bone mass that is achieved at around age 30 years. This study was done to determine whether smoking affects the rate of bone loss in healthy postmenopausal women. Thirty-five smokers (who smoked an average of 15 cigarettes per day) and 285 nonsmokers participated in the 2-year study. In all women, the adjusted mean annualized rate of bone loss from the radius was greater among smokers than nonsmokers (-1.38 percent vs. -0.07 percent per year, respectively). Similar trends were observed in the femoral neck, or calsis, and spine among women who were 6 or more years since last menses (26 smokers and 210 nonsmokers). However, both groups responded equally to calcium supplementation. When compared with nonsmokers, current smokers had accelerated rates of bone loss from the radius and similar trends at the spine, hip, and heel. Thus, smoking, even in amounts of less than one pack per day, has a negative effect on bone health in women after menopause.

o Factor Required for Connective Tissue Maturation

Pyrroloquinoline quinone (PPQ) or related compounds may have potential as a new vitaminlike growth factor. In mice, PPQ deprivation during periods important to neonatal development results in impaired growth and reproduction. The impairment in growth is striking when diets contain less than 100 ng PPQ/g of diet. Normal growth is observed when levels are 300 ng/g of diet. PPQ appears important to maturation of connective tissue proteins, such as collagen and elastin. Lysyl-oxidase, an enzyme involved in collagen and elastin crosslinking, is functionally impaired with PPQ deprivation. Researchers have purified this enzyme and developed antibodies to it. Using these antibodies, a unique enzyme-linked immunosorption assay for lysyl oxidase was developed. The goal is to elucidate mechanisms by which lysyl oxidase function and connective tissue maturation is impaired by inadequate levels of pyrroloquinoline quinone.



## D. Food Composition and Nutrient Bioavailability

### 1. Improved Methods

#### o New Method of Slurry Sampling and Graphite Furnace Analysis for Minerals

A method has been developed which allows solid samples to be analyzed directly for trace elements in a wide variety of materials by preparing slurries and injecting them into a graphite furnace. The overall analysis time has been reduced with each food or biological sample requiring only about 1 minute. Ultrasonic agitation is used to mix slurries.

#### o Inductively Coupled Plasma Emission Spectroscopy for Mineral Analysis of Foods

Many of the existing food composition tables that serve as references for some mineral elements, such as copper and iron, contain data that are based on analyses that were performed over 40 years ago by older chemical methods. Because accurate analyses are needed to determine the variability in mineral content of foods resulting from differences in plant variety, environmental factors, and processing, the concentrations of calcium, copper, iron, potassium, magnesium, manganese, sodium, phosphorus, and zinc were determined by inductively coupled plasma emission spectroscopy in food items selected from the four main food groups. The results indicate that while most of the mineral values compare reasonably well with previously reported values, the newer analytical methods yield slightly lower concentrations of mineral elements for many foodstuffs than were obtained with older chemical techniques. The current methods are also able to quantify some elements previously not reported. Such improved accuracy and sensitivity in analyses is now available to update and verify food composition tables and to determine the cause of variability in mineral content of food items.

### 2. Food Composition

#### o National Nutrient Data Bank

HNIS continues to maintain and expand components of the National Nutrient Data Bank (NNDB) as the primary mechanism for collecting, evaluating, storing, and collating data on nutrient composition of foods. Products of the NNDB are reference values for over 60 food components in thousands of foods Americans consume, including many foods consumed primarily by specific ethnic groups. They are presented in published tables and reports, provisional tables, and machine-readable forms for a wide variety of users. The products are widely recognized as authoritative and are used throughout the world. Of special importance are the data bases prepared for use in assessing the nutrient content of diets reported in large-scale dietary intake surveys conducted by HNIS and by the National Center for Health Statistics (NCHS) in DHHS.

The NNDB is expanded on a continual basis to include results from new analyses conducted by industry, government, universities, and from extramural analyses funded by HNIS. Data reliability is emphasized by utilizing plans representing the national distribution of food types, (1) evaluating performance on check sample analyses during the contractor selection process, (2) requiring

validated analytical methods and documented quality control procedures during contract performance, and (3) promoting uniformity of procedures by encouraging cooperation among contractors, including participation in annual meetings of principal investigators. Plans for extramural research--priorities and procedures--are made in consultation with ARS' Nutrient Composition Laboratory and, as appropriate, other agencies which are major users of nutrient composition data within and outside of USDA and the food industry. Research emphasis is in two areas: food components believed to be important to health promotion and disease prevention and research to fill knowledge gaps for the data base or to monitor published data on nutrient composition of foods.

Analyses were conducted to fill data gaps. Extramural contracts were completed on the comparison of the nutrient content of wild and cultured finfish and shellfish, the nutrient analysis of 23 selected key foods in the U.S. food supply, and analysis of 286 food samples from a nationwide sampling plan for nine minerals. Specialized research was initiated on a number of nutrients in related foods including fatty acids, plant sterols, tocopherol, and cholesterol. Research was also begun on nutrient retention of selected foods.

- o Revision of Agriculture Handbook No. 8, "Composition of Foods...Raw, Processed, Prepared"

Revision and publication of "Composition of Foods...Raw, Processed, Prepared," Agriculture Handbook No. 8, by major food sections, continues by HNIS. The section on Beef Products (AH 8-13) was revised and published in May 1990. It provides data on the nutrients in over 300 retail cuts and reflects current trimming practices which lower the total fat in retail beef cuts. The revision provides data for retail beef cuts trimmed to 1/4-inch of outside fat and with all the outside fat removed. These data are based on results from a recent nationwide market-basket survey that shows meat retailers across the Nation trimming more of the fat from cuts of beef they sell in response to consumers' concerns about the fat content of their diets.

The second supplement to Agriculture Handbook No. 8 was issued in 1990. The supplements, the first issued in 1989, are being issued annually in order to update previously published data and add data for new items. The 1990 supplement included composition data for 80 new items and 34 revised items.

- o Provisional Table on Dietary Components

Provisional tables of food components of special interest to professionals are issued for a selected number of frequently consumed foods as reliable data become available. A provisional table on "The Content of Vitamin K in Selected Foods" was published. Vitamin K is essential for the regulation of blood clotting in the human body. There is a need for individuals treated with anticoagulant drugs to have their vitamin K status carefully monitored and also to monitor their food intake in relation to vitamin K. In addition, cooperation with the Human Nutrition Research Center on Aging at Tufts University, Boston, MA, was initiated for vitamin K analysis to generate a broad data base on key foods.



o Food Composition of Pork Products Studied

Data from the nationwide pork market-basket study on marketing practices and nutrient composition of pork are being evaluated for use in updating the fresh pork composition data for inclusion in the 1991 annual supplement to Agriculture Handbook No. 8. Data from the study show that the fat content for most fresh pork cuts is lower than shown in the last Handbook No. 8 section on pork products published in 1983. The study, conducted by the University of Wisconsin and Hazelton Laboratories, sampled pork products in self-service retail meat cases in 15 cities in 5 geographic regions throughout the United States. Data from these studies, funded largely by industry, are used to update Handbook No. 8 sections, allowing nutritionists, dietitians, and public health officials to more accurately estimate nutrient intakes from foods.

o International Cooperation in Development and Exchange of Food Composition Data

HNIS and ARS' Nutrient Composition Laboratory (NCL) participated in collaborative research in dietary fiber analyses conducted in laboratories in the United Kingdom, Canada, and the United States. The laboratories analyzed 50 U.S. foods, including blind duplicates, by the official procedure of the Association of Official Analytical Chemists (AOAC) and by one or two of three other procedures, including the methods of Englyst (official in the United Kingdom); Mongeau (official in Canada); and Li (AOAC simplified procedure of NCL). Results were reported at scientific meetings and will be used by HNIS to revise and expand the provisional table on total dietary fiber in foods. Several scientific contacts have been maintained with researchers in Canada, several European countries, and the People's Republic of China relative to the procedures used for generating food composition data.

o Nutrient Data Bank Bulletin Board

The Nutrient Data Bank electronic bulletin board, developed by HNIS as a public service to individuals to transfer nutrient data and announcements about HNIS publications and relevant conferences directly to their own computers, was expanded and updated monthly. The board provides information about all current HNIS publications and computer files on the nutrient composition of foods. It was expanded to include a number of data files and food composition publications to permit data users to download them to their own computers. The service is available 24 hours a day, 7 days a week, and has usage by approximately 100 individuals per month from nearly every State.

o Survey Nutrient Data Base System for Large-Scale Dietary Intake Surveys

HNIS is responsible for maintaining the Survey Nutrient Data Base System for developing and documenting special data bases to assess the content of food energy and 27 nutrients in diets reported in dietary intake surveys. The Survey Nutrient Data Base System was updated to include all values needed for data analyses of USDA's 1987-88 Nationwide Food Consumption Survey and data for new foods being reported in the Department of Health and Human Services (DHHS) National Health and Nutrition Examination Survey III (NHANES), which is currently being conducted.



A special data base for processing the Hispanic HANES was prepared and supplied to DHHS based on their specifications. The data base includes the nutrient values for foods representative of the knowledge of food composition for 1982-84 when the Hispanic HANES was conducted. Copies of the Survey Nutrient Data Base System recipe file were provided to the Food and Drug Administration, for their use with USDA's 1987-88 Nationwide Food Consumption Survey data, and to the National Cancer Institute to develop proportions of fruits and vegetables in mixed foods for their long-term colon polyp research.

o Quantification of the Forms of Riboflavin in Foods

The standard procedure for the analysis of riboflavin, an essential nutrient, measures only the total amount of riboflavin in samples. It does not measure the amounts of the three different compounds that exist in foods which have riboflavin activity. An improved procedure has been devised which does this and quantifies all forms (riboflavin, flavin mononucleotide, and flavin adenine dinucleotide) in food. A high-performance liquid chromatographic separation of these forms has been developed on polymer-based columns, using a mobile phase gradient of acetonitrile in citrate-phosphate buffer, pH 5.50. There are no other published methods for simultaneously determining the three principal forms of riboflavin in foods. At present, it is not known whether all three forms of riboflavin exhibit the same vitamin activity. This procedure will enable investigators to answer this question.

o Indigestible Carbohydrates in Protein-Rich Foods

Seeds of many plants provide an important source of protein for humans and other animals. The byproducts from these plant seeds are used mainly for their high protein and amino acid contents. The carbohydrate fraction also provides an important source of energy. A major concern, however, is the high level of alpha-galactosides of sucrose: raffinose, stachyose, verbascose, and ajugose. The intestinal mucosa of humans and monogastric animals lacks the enzyme to cleave these oligosaccharides. Consequently, they escape digestion in the upper digestive tract. When present in high concentrations in the small intestine, these sugars increase the osmotic pressure of the luminal content, which in turn may cause osmotic diarrhea. Flatulence is also one of the physiological effects induced by increased ingestion of legume seeds. A total of 18 meal or cake samples derived from soybean, cotton, sunflower, and rapeseed and 2 samples of field peas were studied using either gas-liquid or high-performance-liquid chromatographic technique. Excellent agreement was found between the HPLC and GLC results for sucrose and raffinose content. Sucrose was the main sugar found in the protein-rich feedstuffs (3.00-7.59 percent of dry wt) but only a minor sugar in cottonseed (0.96-1.14 percent). Stachyose was predominant in soybeans (3.94-4.62 percent) and rapeseed (0.94-1.52 percent), verbascose in field peas (1.69-2.90 percent), and raffinose in cottonseed (3.10-4.52 percent) and sunflower (1.53-2.48 percent).

o Intakes of Trace Elements and Related Nutrients:  
Preliminary Results for 11 Countries

A research program was initiated by the International Atomic Energy Administration in 1985 to obtain reliable comparative data on the average daily dietary intakes of 23 nutritionally important minor and trace elements in various developed and developing countries. The program is due to be

completed in 1991, by which time approximately 450 samples will have been analyzed. To date, approximately one-third of the analyses have been completed. Typical total diet samples and analyses for 22 elements, plus fiber, phytate, and energy have been collected in 11 countries. Median intakes are consistently below current U.S. RDA's for Ca and Zn and above the RDA's for Mn and Mo. Some elements (e.g., I, Mn, and Se) show high variability.

o Fruit and Vegetable Contributions to the Diet

Many nutrition authorities have recommended that the American public increase its consumption of fruits and vegetables. These recommendations have been based primarily on the low animal fat/low cholesterol/high soluble fiber characteristics of diets containing generous amounts of fruits and vegetables. Green and yellow vegetables and citrus fruits are also rich sources of carotenoids and vitamin C. Fruits and vegetables are particularly rich sources of potassium, which can help in the control of hypertension. The U.S. National Research Council in its 1989 report, "Diet and Health," states that a diet containing approximately 3.5 g of potassium daily may contribute to reduced risk of stroke. Fruits and vegetables are also excellent sources of boron, providing about 60 percent of the total dietary intake of this essential trace element. Recent USDA research with human subjects suggests that boron may be involved in building and preserving healthy bones as well as in brain function. Fruits and vegetables also contribute more than one-third of the total dietary intake of nickel. The biochemical function of nickel in higher species is not clear but several animal experiments indicate the essentiality of this element. Fruits and vegetables also contain important amounts of calcium, magnesium, and folacin.

o Dietary Energy and Protein Effects on Fat Content of Beef

The dietary guidelines for Americans recommend that the intake of dietary fat not exceed 30 percent of calories since high intakes of saturated fat have been implicated as a risk factor for coronary heart disease. In a recent study, it was demonstrated that the lean-to-fat ratio of wholesale cuts in beef cattle was significantly improved when steers were fed a high-protein/low-energy diet compared with feeding low-protein/low-energy, low-protein/high-energy or high-protein/high-energy diets. Feeding high energy was associated with more total carcass fat (32.4 vs. 23.9 percent) and less lean (56.7 vs. 60.2 percent) and bone (17.9 vs. 20.1 percent) than a feeding low-energy action. These results suggest that fat deposition in cattle can be significantly and favorably reduced in wholesale cuts by adjusting the relative balance of dietary protein and energy. Statistically significant protein x energy interactions were observed for brisket, flank, and round subcutaneous fat components; brisket, flank, and round lean components; and the bone component of the round. Feeding the high-protein/low-energy diet resulted in the least fat (subcutaneous) and most lean in these cuts. This was also the trend for the other wholesale cuts. Conversely, the other diets yielded more subcutaneous fat and less lean tissue in the carcass. This effect of protein level on body fat content is similar to that observed in broilers some years ago.

o Anticarcinogenic Effect of Naturally Occurring Plant Components

Naturally occurring components of the human food supply have recently received attention as possible agents for cancer chemoprevention. The plant phenol



ellagic acid has been reported to be an effective inhibitor of carcinogen metabolism and certain chemically induced tumors. Therefore, experiments were conducted to determine the effectiveness of ellagic acid as an inhibitor of dimethylbenzanthracene (DMBA)-induced mammary carcinogenesis. Mammary epithelial cell aggregates were isolated from female rats fed control and ellagic acid-containing diets for 25 days. When incubated with DMBA, aggregates from ellagic acid-fed rats exhibited a significant but modest inhibition of DMBA metabolism (33 percent reduction) and DNA-binding (18 percent decrease) as compared to controls. An inhibition of DMBA-DNA binding (40 percent decrease) and DMBA metabolism (61 percent decrease) was also detected when ellagic acid was added to secondary cultures of mammary epithelial cell aggregates containing DMBA. However, a relatively high concentration of ellagic acid was required. Feeding of a diet containing ellagic acid (0.8 percent) for 28 days prior to oral administration of DMBA at 52 days of age resulted in an 18 percent but nonsignificant decrease in mammary tumor incidence as compared to controls. Together, these results indicate that ellagic acid at high doses can inhibit DMBA metabolism and DNA binding with mammary epithelial cells in vitro, but when fed, it was ineffective as an inhibitor of the initiation of DMBA-induced mammary tumorigenesis.

### 3. Bioavailability

#### o Zinc Absorption Increases With Low Intakes in Men

Animal models appear to adjust to reductions in dietary zinc intake by increasing absorption of zinc and/or by reducing losses of zinc in digestive secretions. A study was done with 11 adult men to find out if humans make the same kinds of metabolic adjustments to marginal or inadequate amounts of dietary zinc. The study was done under controlled conditions and all subjects were fed five diets with adequate (10 mg/day) or inadequate levels of zinc (1, 2, 3, or 4 mg/day). Plasma zinc and other biochemical measurements in blood showed that the diets with 1 or 2 mg zinc/day did not contain enough zinc to meet metabolic needs. Zinc absorption and zinc loss from digestive secretions were measured by using stable (nonradioactive) tracers of zinc. Zinc absorption was much higher (93-96 percent) when the four low-zinc diets were fed than when adequate zinc was fed (63 percent). Men fed low-zinc diets also had reduced losses of zinc from digestive secretions to about one-fourth the amount lost when adequate zinc diets were fed. However, these metabolic adjustments were not sufficient to prevent development of zinc deficiency when the lowest amount of zinc was fed.

#### o Dietary Protein Enhances Zinc Absorption in Humans

Previous research indicates that increasing the amount of protein in a meal improves absorption of the essential nutrient zinc. A study was conducted to test whether there is a maximum amount of protein that will result in enhanced zinc absorption and whether enhancement would occur in the presence or absence of phytic acid and fiber, present in wheat bran. Twenty volunteers consumed meals containing 10, 30, or 50 g protein (casein, a milk protein) with either whole-wheat or white rolls. The rolls were supplemented to contain similar amounts of zinc. Trace amounts of the radioisotope  $^{65}\text{Zn}$  were added to the rolls, which allowed subsequent measurement of the amount of zinc retained by the participants. Average zinc absorption ranged from  $8 \pm 4$  percent for those fed the whole-wheat rolls and the least protein to  $26 \pm 7$  percent for those eating white rolls and the most protein. Although a considerable amount



of protein was added, there was no indication that maximum zinc absorption had been achieved. Although less zinc was absorbed from whole-wheat than from white rolls supplemented to the same zinc content, the enhancing effect of protein on zinc absorption was similar with both types of rolls. Not only are most protein-containing foods good sources of zinc, but it appears that they also substantially improve the intestinal absorption of zinc.

o One-Fourth of Zinc Retained From Representative U.S. Diets

The Recommended Dietary Allowances are based on retention of nutrients from typical diets. To investigate retention of zinc from U.S. diets, two research diets were devised using 200 foods in the average amounts consumed by 25-30 year-old U.S. men and women. The women's diet contained 7.8 mg zinc (analyzed) and 1,570 kcal (calculated) daily; the men's diet contained 14.0 mg zinc and 2,470 kcal. The diets were consumed by 14 women and 14 men for 9 weeks. Although the food lists for these diets were intended to represent typical total diets in the United States, they did not provide sufficient energy for weight maintenance. Both men and women lost about 9 pounds. Zinc absorption was measured by adding a tracer dose of zinc radioisotope to the entire 3-day menu. Women absorbed a larger proportion of zinc from their diet than did men (29 vs. 22 percent) but less total zinc (2.3 vs. 3.1 mg) and excreted the absorbed zinc faster than the men. Oral contraceptives did not affect zinc retention. Men and women absorbed similar amounts of zinc when adjusted for body weight. Although the discrepancy in body weight between men and women was less than the discrepancy in dietary zinc, the women apparently compensated by absorbing zinc more efficiently. Approximately a quarter of the zinc in a representative U.S. diet was absorbed.

o Manganese Absorption in Humans

Manganese (Mn) is a trace element believed to be essential for human health, but little is known of how much Mn is absorbed or retained from the diet. One of the few ways to study Mn absorption in humans is to feed foods labeled with a radioactive trace of Mn and to follow the tracer in the body. One would prefer to be able to add a pure chemical form of the Mn tracer to any food of interest (extrinsic tracer). To find out if it is valid to use extrinsic tracers to study Mn metabolism, lettuce, spinach, wheat, and sunflower seeds were grown that had Mn incorporated into the plants while they were growing (intrinsic tracers). Both intrinsically and extrinsically labeled plants were then fed to men and women, and their body content of radioactive Mn after the meals was monitored. Radioactive manganese chloride was also fed to all the subjects so that the results among groups of subjects could be compared. It was found that both the intrinsic tracers and the extrinsic tracers were absorbed and excreted at the same rates. This means that in the future, scientists can use extrinsic tracers to study Mn absorption instead of growing special labeled foods. Mn absorption was highest from lettuce (5.2 percent) of the four foods tested.

o Effect of Phytate on Mineral Balance in Men

This study tested the effect of three levels of phytate intake on mineral balance of humans. Phytate is a phosphorus-containing compound that is present naturally in seeds, particularly in the outer or bran portion of cereal grains. In the testtube, phytate will complex with several elements

which are essential dietary nutrients for humans. Twelve men consumed two muffins at each meal along with other foods typically consumed by Americans. For 15 days, the muffins provided a level of phytate intake typical for nonvegetarian Americans; for another 15 days, the intake level was typical of most American vegetarians; and a third 15-day period approximated the maximum amount that is likely to be present in the diet of American vegetarians. When the high-phytate muffins were consumed, excretion of calcium, zinc, and magnesium in stools was greatest, indicating that bioavailability of these nutrients was less in the presence of the high phytate. No effect was observed of phytate intake on iron, copper, and manganese balance. Even though few Americans consume the high level of phytate, these results suggest that high phytate intakes may increase the dietary requirement for calcium, zinc, and magnesium.

#### o Relationship of Iron Absorption to Iron Status

Iron deficiency anemia is still a health problem in the United States, especially in pre-school children and in women of childbearing age. The amount of iron in the body is controlled mainly by how much is absorbed from food in the intestine, but this process is not well understood. It is known that not all food iron is absorbed, either because it is not in an absorbable form in the food or because something in the intestine itself prevents iron absorption. Rats were fed diets containing 7 mg iron/kg diet (-Fe rats) or 160-200 mg iron/kg diet (+Fe rats) for 3 weeks prior to a 10-minute test of  $^{59}\text{Fe}$  absorption from an in vivo ligated duodenal segment. During the absorption test from  $^{59}\text{FeCl}_3$ , the oxidation-reduction potential became more "reducing," the pH rose in segment contents, and there were small but significant and reproducible differences between the iron uptake of -Fe and +Fe rats. Sulfhydryl concentration in the human was found to be positively correlated with iron uptake in -Fe rats, but negatively correlated with iron absorption in +Fe rats. The results of this study suggest a previously unreported process, promoted by the intestinal tissue to prepare food iron for absorption. This process appears to involve sulfhydryl compounds, which can efficiently reduce iron from the normal "oxidized"  $\text{Fe}^{+3}$  form to the more soluble--and therefore more absorbable--"reduced"  $\text{Fe}^{+2}$  form. Sulfhydryl compounds apparently are secreted into the intestine where this process occurs. This finding should stimulate new thinking about the iron absorption process and its regulation and may lead to new strategies for preventing and treating iron deficiency anemia.

#### o Characterization of a Pea Mutant Favoring Iron Uptake

Iron is an essential nutrient for plants, animals, and humans, and iron deficiency is a worldwide problem. Acquiring sufficient iron from alkaline soils is difficult for plants; hence not enough iron is available in many plant foods to satisfy the adult human's requirement when eaten in normal amounts. Recently, a single-gene pea mutant (named El07) was discovered which accumulates very high iron levels in its older leaves. We have shown that El07 accumulates iron because it acts as if it were continuously iron-deficient, i.e., the roots continue to take up large quantities of iron. One mechanism involves a membrane-bound system (reductase) which reduces the iron, thus converting it to a form which is readily absorbed by the plant. El07 appears to have this system continuously activated and operating at a



higher rate than in normal peas. Also, the extent of the root system involved in iron reduction is much greater in El07. Studying this mutant will result in a broader understanding of the mechanisms which regulate iron absorption in all plants. This information will be used in our efforts to improve the nutritional quality of plant foods with respect to iron.

o Naturally Occurring and Enriched Boron Isotopes in Plant Foods

While boron may be an essential mineral in human nutrition, there have not been any nutrition studies which follow boron in biological systems because there are no radioactive isotopes of boron. However, there are two stable isotopes of boron,  $^{11}\text{B}$  and  $^{10}\text{B}$ . In anticipation of the use of these stable isotopes to study boron nutrition in humans, the ratios of boron isotopes in commercially available fruits and vegetables have been determined and found to be different for each food. This was not unexpected because boron isotope ratios are also different in rocks and minerals. Nutrition studies with stable boron isotopes will require careful control of naturally occurring stable boron isotopes in foods. Hydroponic techniques have been employed to grow cabbage and broccoli in a greenhouse using only one of the boron isotopes. Using a boron-specific ion-exchange resin to isolate the boron and thermal ionization mass spectrometry to measure it, boron recovery from hydroponic broccoli was 59 percent and from carrots, 74 percent. This work showed that vegetables can be grown with boron ratios very different from those found in nature. Such hydroponically grown vegetables will be suitable for use in future boron human nutrition research.

E. Food and Nutrition Monitoring Research

Food consumption by Americans is monitored and their diets are assessed for nutrient content as part of the National Nutrition Monitoring System (NNMS). The five major NNMS categories are health and nutrition status measurements, food consumption measurements, food composition measurements, dietary knowledge and attitude assessment, and food supply determination. USDA has a long history and a prominent role in three: food composition measurement, food supply determinants, and food consumption measurements. With the launching of the Diet and Health Knowledge Survey with respondents from the 1989 and 1990 Continuing Survey of Food Intakes by Individuals, USDA has established a prominent role in the area of dietary knowledge and attitude assessment. Progress has been made towards the goals and plans for the NNMS as outlined in the Joint Operational Plan for the National Nutrition Monitoring System from 1987 to 1996 and provided to Congress. Passage of the National Nutrition Monitoring and Related Research Act of 1990 has introduced statutory requirements for development and coordination of nutrition-monitoring activities which are being implemented jointly by USDA and DHHS.

1. U.S. Food and Nutrient Supplies

a. Food Disappearance Data

The Economic Research Service (ERS) annually calculates the amount of food available for human consumption in the United States. The food supply data series is a long, continuous series, published first in 1941 and extended back to 1909 for most commodities. It is the only data set available for



determining long-term trends in supply and consumption by major food groups. It covers the complete spectrum of primary foodstuffs. Hence, it can be used to measure interrelationships between foods and for measuring total food supply and apparent use. It is particularly useful for estimating complete demand systems that measure price and income elasticities of demand in a consistent way. HNIS uses the ERS data set to estimate nutrients available for human consumption per capita per day. The nutrient content of the U.S. food supply series also dates from 1909. Food supply determinations are one of five components of the National Nutrition Monitoring System.

Total food supply in the United States, and most other countries, is based on records of commodity flows from production to end uses. This involves the development of supply-utilization tables for each major commodity from which human foods are produced. Total available supply is the sum of production, beginning inventories, and imports. These three components are either directly measurable or estimated by government agencies using sampling and statistical methods. Often, production is measured at the farm level; however, for some products, primary production is measured at the first level of processing. For most commodity categories, measurable uses are exports, industrial uses, farm inputs (e.g., seed), and end-of-year inventories. Normally, human food use is not directly measured or statistically estimated. The availability of food for human consumption is, therefore, a "residual" component after subtracting other uses from the available total supply. It represents disappearance of food into the marketing system. Hence, it is often referred to as "food disappearance." Per capita food consumption is calculated by dividing total food disappearance by the U.S. population.

#### b. Food Consumption, Prices, and Expenditures

The food supply data series was updated in FY 1990 in Food Consumption, Prices, and Expenditures, 1967-88 (FCPE), ERS, USDA, SB-804, May 1990. FCPE is an annual publication. The data series was discussed and summarized in the National Food Review 1990 Yearbook: A Decade In Review (ERS, USDA, Volume 13, Issue 3, July-September 1990) and other USDA publications. Agricultural Handbook 671, Major Statistical Series of the U.S. Department of Agriculture, Volume 5: Consumption and Utilization of Agricultural Products (ERS, USDA, October 1989) describes the construction and use of annual series on per capita food consumption (disappearance), the index of per capita food consumption, and total food expenditures, which are included in FCPE.

#### c. Long-Term Trends

The American food supply has changed quite a bit over the past two decades. Here are some of the highlights from the FCPE bulletin:

- o In 1989, total meat, poultry, and fish available for consumption reached a record 187 pounds per person (boneless, trimmed equivalent), 6 pounds more than in 1971. However, we consumed an average of 24 pounds less red meat, 26 pounds more poultry, and 4 pounds more fish and shellfish than in 1971.
- o Apparent egg consumption dropped from 310 eggs per capita in 1971 to 235 in 1989.

- o Per capita use of total fluid milk declined steadily from 271 pounds in 1971 to 229 pounds in 1988. Whole milk's share fell from 80 percent in 1971 to 46 percent in 1988. Consumption of lowfat and skim (including buttermilk and lowfat and nonfat yogurts) milk products increased from 20 to 54 percent.
- o Cheese use nearly doubled from 12 pounds per person in 1971 to 23.6 pounds in 1988. Cheddar cheese, Americans' favorite, increased 59 percent to 9.5 pounds per capita. Italian cheese consumption more than tripled. Mozzarella quadrupled from 1971, reaching 6 pounds per capita in 1988.
- o Fluid cream use was 7.2 pounds per capita in 1988, up from 4.8 pounds in 1971. However, it was still just over half of the 13.6 pounds in 1946. As cream sales fell between 1946 and 1972, the probability of getting cartons of spoiled cream increased dramatically. Consequently, consumer dissatisfaction and industry costs rose because of a high rate of return of spoiled product. Sales began to reverse when ultrapasteurization was widely adopted in the early 1970's, increasing the shelflife of cream products. This brought single-serving packages of cream back into the restaurants. Policy changes at about the same time resulted in a decrease in the relative prices of milkfat and, consequently, cream. High Federal dairy support prices made cream more expensive than imitation cream products, encouraging their production and use.
- o Per capita supplies of visible fats and oils (butter, margarine, shortening, salad and cooking oils, lard, and edible tallow) increased 21 percent from 1971, reaching 62.7 pounds per person (on a fat-content basis). A 39-percent increase in vegetable fats and oils (mainly shortening and salad and cooking oils) more than offset a 26-percent decrease in the use of animal fats (lard and butter).
- o Total per capita supplies of nine major commercial fresh vegetables reached a record high in 1988--20 percent more than in 1980 and 37 percent above 1971. Onions, lettuce, and tomatoes rose about 5 pounds each and carrots and broccoli more than 3 pounds each over the two decades.
- o Fresh fruit availability gained 19 pounds per capita from the 1971-73 average to a total of 94 pounds (retail-weight equivalent) in 1988. The rise was due entirely to sharp increases in fresh noncitrus fruits like bananas, grapes, apples, avocados, pineapples, and strawberries.
- o Per capita availability of flour and cereal products rose from an annual average of 142 pounds in 1971-73 to 172 pounds in 1988. However, this is still considerably below the 204 pounds consumed in 1945-49 and 287 pounds in 1909-13. Rice, pasta, and breakfast cereals together increased 55 percent between 1971 and 1988 to 41 pounds per person.
- o Americans increased per capita caloric sweetener consumption (dry basis) 16 percent during 1966-88 to 133 pounds. Increased use of high-fructose corn syrup (HFCS) cut food use of refined sugar from the



record 102 pounds per capita in 1972 to 62 pounds in 1988. HFCS, glucose, and dextrose (all corn sweeteners) became economical because of abundant corn supplies and low corn prices. At the same time, Federal policy ensured high support prices for domestic sugar growers through import quotas on refined sugar. In 1985, total corn sweeteners surpassed cane and beet sugar use for the first time.

- o U.S. per capita use of low-calorie sweeteners (mainly aspartame and saccharin) increased faster than caloric sweeteners in the 1980's. By 1988, low-calorie sweetener use was about 20 pounds (sugar sweetness equivalent) per person, accounting for nearly 13 percent of total sweetener consumption, compared with 6 percent in 1980. This segment of the sweetener industry is changing rapidly because of new uses for low-calorie sweeteners approved by the U.S. Food and Drug Administration (FDA), introduction of new sweeteners (e.g., acesulfame-k, which entered U.S. commercial use in 1988), and growth in the "light" food segment of the food industry. Other high-intensity, low-calorie sweeteners (including alitame, which is 2,000 times sweeter than sugar, and sucralose, 600 times sweeter than sugar) are awaiting approval by FDA. Cyclamate use was banned by FDA in 1970 but is being considered for certain restricted uses.

## 2. Food Consumption Surveys

### a. Collecting and Reporting of Nationwide Survey Data (HNIS)

During the year, work proceeded on three different but concurrent nationwide food consumption surveys involving all stages of the survey process simultaneously. Survey activities were in five main areas: (1) completing the documentation and release of public use data tapes and preparing for publication of results from the 1987-88 Nationwide Food Consumption Survey; (2) supporting technical aspects of data processing and analysis and preparing for publication of descriptive tabular results from the 1989 Continuing Survey of Food Intakes by Individuals and the follow-up Diet and Health Knowledge Survey; (3) supporting technical aspects of launching the 1990 Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey including interviewer training, data collection, and processing; (4) planning for the 1991 Continuing Survey of Food Intakes by Individuals; and (5) planning for future activities conducted as part of the NMMS.

### o Nationwide Food Consumption Survey 1987-88

Results from the 1987-88 Nationwide Food Consumption Survey (NFCS) were made available. The 1987-88 NFCS is the sixth decennial food consumption survey conducted by USDA since the first in 1935-36. Sample selection, data collection, and data processing were conducted under contract by National Analysts, Division of Booz, Allen, and Hamilton, Inc. The NFCS includes two components--household use and cost of food for a 7-day period (household component) and intake of food by individual household members for a 3-day period (individual component). Data collected include detailed information on food used by the entire household during a 7-day period, on the price paid for each food bought, and on the food each member ate over 3 days, both at home and away. Questions were also asked about demographic and socioeconomic characteristics of households and household members. Data collection began in



April 1987 and was completed in August 1988. Data tapes for 3 days of dietary intake were provided to the Environmental Protection Agency, the Food and Drug Administration, and the Federal Trade Commission and to the National Technical Information Service for public distribution. Several speeches reporting NFCS results were presented at national professional meetings. The first two reports are in preparation. These reports are a popular chartbook on "Diets of Americans" and a statistical tabular report on "Food and Nutrient Intakes, 1 day."

o NFCS Design and Response Analyses

The 1987-88 NFCS was designed to provide a multistage stratified area probability sample representative of the 48 conterminous States. The target sample was 6,000 households, projected to yield 15,000 individuals. About 35 percent of the households drawn into the sample chose to participate. This response rate is lower than in previous surveys. Nonresponse is becoming an increasing problem for public and private agencies that conduct surveys. The impact of nonresponse upon integrity of the data for planned applications is being addressed through a variety of analyses and reviews.

One type of analysis conducted involves comparing sample demographics of the 1987-88 NFCS with those of the general population as reported by the Census Bureau in the March 1987 Current Population Survey for 13 characteristics believed to be correlated with eating behavior. This analysis has shown good agreement between the unweighted sample and the current population for the characteristics of region, presence of children and adults in households, food stamp use, tenancy, male and female head employment, race, and age.

Characteristics not as well matched by the sample with the population were females 20 years and over, older individuals, households with income exceeding 500 percent of poverty, and households in which the female head was employed. Some of these differences between the survey sample and the population are not surprising. For example, the respondent burden for the survey, particularly the household portion, falls primarily on the main meal planner/preparer, which traditionally is the female head of the household.

In order to adjust for some of the differences found, HNIS has worked with statisticians at Iowa State University to develop post-stratification weighting of the data so that the sample characteristics match population characteristics. HNIS has contracted with the Federation of American Societies for Experimental Biology to convene an independent expert panel to review the survey design and execution with emphasis on implications of nonresponse.

Changes made in 1987-88 NFCS from the 1977-78 NFCS in interview and food coding procedures, as well as changes made to update nutrient and recipe file data bases, were assessed in a 1988 Bridging Study conducted under contract. The field experiment involved a sample of nearly 700 women who were surveyed using the methodology employed in the 1977-78 or 1987-88 NFCS depending on assignment to one of two treatment groups. The study indicates that changes in interview and coding procedures had minimal effect on reported results when

NFCS 1987 and NFCS 1977 methods were compared. However, some data changes were noted that involved improvements in food composition data as well as actual changes in particular foods. Results have been presented at professional meetings and published in the report "Effects of Procedural Differences Between 1977 and 1987 in NFCS on Estimates of Food and Nutrient Intakes."

o Continuing Survey of Food Intakes by Individuals

The Continuing Survey of Food Intakes by Individuals (CSFII) was reinstated in 1989 on a yearly basis. The CSFII has two separate samples including all members in 1,500 households in the general population and 750 households in the low-income populations. The survey is designed to obtain 3 days of food intake data from all members of the household in addition to sociodemographic data and general questions on the respondent's diet and health. Data reporting will be accomplished using a moving average approach of multiple surveys by sex-age groups. Data collection for the 1989 CSFII was completed on schedule for both the basic and low-income samples. Data collection for the 1990 CSFII began on April 1, 1990, and is operating according to the established schedule.

o Diet and Health Knowledge Survey

Beginning with the 1989 CSFII, a new type survey was initiated to assess the dietary knowledge and attitudes of survey participants. It is called the Diet and Health Knowledge Survey (DHKS) and is conducted as a telephone follow-up with only the main meal-planner/preparer in the household. The two major purposes of the survey are to improve our understanding of factors that affect food choices and to obtain information on people's knowledge and attitudes about the concepts promoted by the Dietary Guidelines for Americans. The 1989 DHKS has been completed and preliminary data analysis begun. Results provide information about potential roadblocks to dietary improvements including lack of awareness, motivation, and knowledge; inaccurate perceptions; and confusion about advice. These results have significant implications for nutrition education. For example, more than 40 percent of respondents said their diets were "about right" in fat. But in the 1985 Continuing Survey, only 12 percent of women 19 to 50 years old had fat intakes at or below 30 percent of calories, the level recommended in the 1990 Dietary Guidelines for Americans. For saturated fat, about half of the DHKS respondents thought their diets were "about right." But in 1985, only 10 percent of women 19-50 had intakes meeting the current recommendation of less than 10 percent of calories. Data collection for the 1990 DHKS is under way and preparation for two DHKS published reports are being made which will provide results on respondents' attitudes and knowledge about nutrition in relationship to their diet quality.

o Nutritional Survey of Farm Families

Nutritional status, energy expenditure, body fat, and chronic disease risk factors were measured on 162 adult males and females in farm families in one area. Mean energy intake was about 2,400 and 1,800 kcal/day for males and females, respectively. Mean nutrient intakes for both males and females met the Recommended Dietary Allowances (RDA) for most nutrients. However, the distribution of intakes for most vitamins and minerals suggested that a considerable portion of this population consumes far less than the RDA. More



than 30 percent of females consumed less than 75 percent of the RDA for calcium; iron; zinc; copper; magnesium; and vitamins B6, B12, and folacin while more than 30 percent of males consumed less than 75 percent of the RDA for magnesium and folacin. The diet of males was more likely to meet the RDA than females because of the greater food intake. Fat provided about 40 percent of the total caloric intake. Energy intake and energy expenditures estimated from 4-day activity records were low for both males and females. Body fat as measured by skinfolds indicated prevalence of obesity of 71 percent for males and 56 percent for females. Elevated blood pressures were present in 50 percent of the subjects. Elevated cholesterol was present in 20 percent of the subjects.

o USDA/University of Texas Food Intake Analysis System

HNIS is cooperating with the University of Texas School of Public Health to develop a microcomputer system utilizing USDA's Survey Nutrient Data Base and survey questionnaires to provide a survey operations management network. The PC network will be designed for two purposes: (1) to provide an efficient state-of-the-art system for survey contractors to use for coding dietary recall and food intake records, and (2) to provide automated procedures for HNIS to efficiently maintain the food code system and to monitor and measure quality of a contractor's performance. The coding process, including the contractor's communications with HNIS to solve coding problems, is the most time-consuming part of a survey. The new system will streamline this process, and problems can be transferred electronically to HNIS for resolution. The network design of the system will permit HNIS to have a direct link to the coding process and to obtain periodic reports measuring actual performance of coders and supervisors against HNIS expectations. Indirect measurements of interviewer performance can also be made through this system. Testing of the network and preparation of documentation and training materials are being developed so that a completed system will be available for trial by prospective contractors in 1992.

o National Nutrition Monitoring System (NNMS) Plans

USDA's system of Nationwide Food Consumption Surveys, including NFCS and CSFII, are major components of the NNMS.

The Operational Plan for NNMS from 1987 to 1996 highlights plans for monitoring activities into the mid-1990's. USDA's role involves the following:

- Annual estimates of the food and nutrient content of U.S. per capita food supplies by ERS and HNIS.
- Continuation of food composition research and measurements by HNIS and ARS.
- Continuation of maintaining, updating, and documenting food composition data files and food coding systems for use in NFCS, CSFII, and NHANES diet assessments.
- Reporting results from NFCS 1987-88, the 1989 and 1990 CSFII, and the 1989 and 1990 DHKS in published reports and public use data tapes.



- Conducting the CSFII in 1991.
- Conducting the DHKS as a followup telephone interview to the CSFII on consumers' knowledge, attitudes, and perceptions on diet/health issues.

- o Third Report of National Nutrition Monitoring System (HNIS)

One of the goals of the Operational Plan for NNMS is the development of a system for reporting on the dietary and nutritional status of the U.S. population. USDA and DHHS have jointly implemented a reporting system that integrates results of the monitoring system components into comprehensive reports. Two such reports have been sent to Congress--the first in 1986 and the second in 1989. Plans are being made for the third report on the dietary and nutritional status of the U.S. population, which is to be sent to Congress in 1992. As a first step in planning this report, information has been collected from individuals and groups representing nutrition and health professionals and policymakers who were users of the first two reports. Information collected through meetings and teleconferences has included uses and usefulness of the data and special topic areas in the reports and ideas related to the focus and presentation of the third report. Recommendations received include that the report should feature more charts and graphs and less text; emphasize topics and data related to current public health concerns, particularly targeted in health-promotion activities; include more data subdivided by region, race, ethnic group and income and on food consumption and dietary knowledge and attitudes; and involve non-Federal professionals in its preparation. Plans are to also solicit information from Congress and assess recommendations received in developing the focus and presentation of future reports.

- o Food Safety Data Initiative

During 1990, the Department established the Food Safety Data Initiative (formerly the Pesticide Data Program) to increase our knowledge of the use and impact of agricultural pesticides. Four USDA agencies are involved in the initiative. The National Agricultural Statistics Service (NASS) will put in place a continuing survey of farm use of pesticides. The Economic Research Service (ERS) will evaluate the economic impact of changes in pesticide availability and alternative farm management techniques. The Agricultural Marketing Service (AMS) will coordinate a State-based program to monitor pesticide residues in selected agricultural commodities. HNIS will develop a Food Grouping System which will translate data from food consumption surveys on the amounts of the more than 5,000 food items consumed by individuals back to the agricultural products of which they are composed.

- b. Research on Determinants of Dietary Status and Survey Methods

HNIS maintains an active program in survey methods research through intramural and extramural projects. The following text highlights projects of investigators at colleges and universities using 1987-88 NFCS data.

- o Analysis of Variations in Food Consumption Across Household Types and Over Time

The variation in food consumption by food group (and thus dietary status) across different types of households as well as the variation over time among households of a given type was examined at Cornell University. Study utilizes data from the household portion of the Nationwide Food Consumption Surveys of 1977-78 and 1987-88.

- o Analysis of Effects of Economic, Demographic, and Food Choice Variables on Individuals and Household Nutritional Adequacy in United States

The effects of different economic factors, demographic variables, and food group choices on the nutrient consumption of households participating in the 1987-88 NFCS are being examined at the University of California-Berkeley. An economic model approach is being used to determine nutrient shadow prices that are specific to the survey, region of the country, season of the year, and level of urbanization. The effect of differing demographic, health, and economic factors; nutrition program participation; and food group choices of individuals and their households on the nutrient intakes of individuals participating in NFCS 1977-78 and NFCS 1987-88 is also being studied. A consumer behavior model will be used with nutrient shadow prices, food group intakes, and a variety of nondietary variables to derive parameter estimates for a system of demand equations with a separate equation of each nutrient in the data set. Marginal propensities to consume and demand elasticities will be estimated for the nutrients being considered.

- o Analysis of Importance of Socioeconomic, Demographic, and Personal and Health-Related Factors and Food Product Attributes on U.S. Nutrient Intakes and Implications for Dietary Status of Households

Scientists at Washington State University are analyzing 1987-88 NFCS data to identify how households value the nutritional and nonnutritional attributes of foods from which nutrients are obtained. Models being tested are attempts to extend the standard neoclassical model of utility maximization which does not explicitly account for the quality of goods. Analyses were performed using 1977-78 NFCS and preliminary 1987-88 NFCS data from 252 households.

- o Methodological Research--1987-88 NFCS and CSFII

Researchers at Iowa State University are determining the correlation structure of data obtained from three or more consecutive days' dietary intake data. This will help determine the relative statistical efficiencies of alternative survey designs and provide information on methods of combining data from different surveys. They are continuing to estimate usual daily intake distributions. These estimates will be used to determine relationships between intakes and household and individual characteristics and will be incorporated into existing nutrient consumption functions.



o Determinants of Food Consumption in American Households

The Economic Research Service is quantifying the economic and demographic factors determining food consumption patterns in American households. This information will provide a better understanding of the way U.S. food supplies are distributed among households and factors associated with food use patterns. The project includes a series of progressive investigations that are designed to address a number of critical analysis issues and problems along the way. To achieve the objective, two parallel analyses will be undertaken. One analysis will pool data from NFCS 1977-78 and NFCS 1987-88 to estimate demand parameters from the basic samples. A second analysis will pool data from the 1977, 1979, and 1987-88 NFCS low-income samples.

o Within-Person Variation in Dietary Intake

Sources and nature of within-person variation in estimates of energy and nutrient intakes across time and implications for analysis of survey data are being identified at the University of Toronto. Estimates of within-person variation usually reported have been population estimates--average values for the study group as a whole. Examination of day-to-day variation of individuals indicates that there are wide individual differences in their stability of intake. In this study, the ARS Beltsville longitudinal data set, which comprises 1 year of continuous dietary intake records for 29 men and women, is being analyzed to determine within-person variation, how it differs between persons, and whether it is characteristic of a person.

o Prediction of High-Risk Dietary Patterns

A scientist at Arizona State University is using 1987-88 NFCS data to identify those characteristics in which specific dietary patterns are most likely to occur in individuals. The specific dietary patterns to be explored are those which might put the individual at increased risk of inadequate nutrient intake or of diet-related heart disease.

o Dietary Status and Eating Patterns

The relationship between patterns of eating and several alternative measures of dietary status using 1987-88 NFCS is being analyzed at the University of North Carolina. Eating pattern trends and dietary status trends will be explored for the overall population and selected groupings of interest.

o Knowledge and Attitudes Related to Dietary Choices Among U.S. Men and Women

At the University of North Carolina, scales are being developed to measure different dimensions of people's knowledge about and attitudes toward healthy eating using data from the 1989 DHKS. The scales will be used to examine the extent to which factors such as age, health status, income, employment, education, race, ethnicity, and family structure contribute to differences in knowledge about and attitudes toward healthy eating. They will also be used with data from 1989 CSFII to examine the extent to which knowledge about and attitudes toward healthy eating contribute to differences in dietary status.



o Improving Methods for Assessing Nutrient Intake

Scientists from five States collaborated in studies to improve methods of dietary assessment. The adequacy of obtaining information with Food Frequency Questionnaires (FFQ) was compared to traditional 3-day diet records. When compared to the 3-day diet records, mean intake levels for calories and most nutrients were higher when obtained through food frequency questionnaires. Comparison of the nutrient levels obtained from food records, expressed per 1,000 kcal, with national NHANES data showed intakes similar for all nutrients except for vitamin A, vitamin C, and calcium, which were higher for the food frequency method. Food and beverage portions were estimated with and without portion estimation aids--measuring utensils and photographs. Measuring utensils were somewhat better than pictures in reducing errors or estimation. Meat portions, however, were poorly estimated with and without aids.

In another study, 3-day diet records showed significant correlation to a 98-item FFQ for most nutrients. An interview-assisted short FFQ (34-item) also showed strong potential as a surveillance instrument to detect gross nutrient inadequacies in older adults. In a subsequent study, a sample of men 65 years and older completed shorter and longer forms of an FFQ. Mean nutrient intakes were found to be similar, but sufficient time was saved in the shorter version to recommend it for future studies. The interview-assisted short Food Frequency Questionnaire method appears to be the protocol most useful for screening elderly populations.

o Review of WIC Food Packages

Public Law 101-147 mandates that USDA conduct a review of the appropriateness of the WIC food packages. USDA is required to examine the nutrient density of foods; to consider how effectively protein, calcium, and iron are provided to WIC participants; and to consider the extent to which nutrients, for which program participants are most vulnerable to deficiencies, such as iron, thiamine, riboflavin, vitamin A, and zinc, are effectively provided to participants. A preliminary report was due to Congress by June 30, 1991, and a final report by June 30, 1992.

o Review of WIC Nutritional Risk Criteria

Public Law 101-147 mandates that USDA, in consultation with WIC State and local agency directors and other nutrition experts, conduct a review of the relationship between nutritional risk criteria and the participant priority system in the WIC Program. The legislation directs USDA to consider the preventive nature of the program and to examine risks to eligible persons, especially pregnant women, from conditions such as homelessness and mental illness and conditions that pose barriers to the receipt of prenatal care and that may increase the probability of adverse pregnancy outcomes or other adverse effects on health. A preliminary report was due to Congress by October 1, 1990, and a final report by July 1, 1991.

- o Child Nutrition Program Operations: Onsite Meal Observation Study

This study provides for the collection of data through onsite observations of National School Lunch and School Breakfast Program meals. Data will be collected on what foods are prepared and what foods are selected and consumed by children. Observations will be made in a total of 60 schools in 20 school districts: 10 "exemplary" districts in terms of their efforts to try and reduce sodium, fat, and sugar and 10 "regular" districts. Exemplary districts will be identified by FNS, while the other districts will be selected purposely to include variation in geography, district size, and presence of "offer vs. serve" in elementary schools.

- o Menu Modification Demonstrations

FNS awarded 3-year grants to five school food authorities to conduct menu modification demonstration projects. These sites will demonstrate local efforts to improve the nutrient content of meals served, particularly in the areas of reducing fat and sodium. During the 1990/91 school year, grantees will implement recipe, food specification, and food preparation modifications to meet their individual fat and sodium content goals.

- o Dietary Assessment of School Nutrition Programs

The primary objectives of this study are to determine the nutrient content of meals offered to students, to assess the impact of USDA meals on student meal specific and total dietary intake, and to compare the study's dietary intake findings to previous findings. Secondary objectives include determining which meal preparation factors significantly affect the nutrient content of USDA meals, identifying the USDA and non-USDA foods selected by students, and measuring the extent of plate waste under the "offer vs. serve" (OVS) option and non-OVS systems. Generally, the study examines the nutrient composition of meals offered to students, the types of foods selected by students, and the nutritional value of foods consumed by students.

- o WIC Modeling and Analytic Projects (MAP)

The major objectives are to: (1) analyze health and nutrition characteristics of participants and eligibles (i.e., health status, nutritional risk, dietary intake, eligibility, and breastfeeding), (2) analyze effects of WIC participation on infant mortality, health status, child development, and cost-benefit ratios, (3) provide exploratory and conceptual analyses on the effect of WIC infant formula rebates on formula prices, market shares for WIC foods, and portion of the income-eligible population at nutritional risk, (4) model program dynamics on eligibility and provide State-specific eligibility estimates, and (5) provide capability for ad hoc analyses at FNS' request. The project may extend into 1993.

- o Study of WIC Participant and Program Characteristics

Public Law 99-500, enacted in 1986, requires FNS to submit a biennial report to Congress on the income and nutritional risk characteristics of participants in the WIC Program. To satisfy this requirement, FNS sought to develop and implement a system of gathering, analyzing, and publishing WIC Program information. The information sought includes periodic descriptions of the characteristics of State and local agencies which operate the program and



periodic descriptions of the characteristics of individuals participating in the program. Data for the 1990 report are being gathered from a national sample of participant records. As part of the groundwork for future data collections, a Minimum Data Set has been agreed upon and technically specified for use in 1992 data collection. States will generally submit a census of participants for approximately 20 data elements directly generated from ongoing management information systems serving the WIC Program.

- o WIC Child Impact Study Field Test

The purpose of the Field Test is to address FNS concerns regarding the practical implementation of a study design suggested by an earlier design feasibility study. Two research designs will be simultaneously field-tested: the design developed during the feasibility study and an alternative design proposed by the field-test contractor. In addition to testing the designs, this effort will test data collection measures and procedures and obtain data that addresses WIC's impact on children. The field test is scheduled to be completed in August 1991.

- o CDC-FNS Cooperative Project on Smoking Cessation During Pregnancy

A cooperative agreement with the Centers for Disease Control (CDC) extends its Smoking Cessation During Pregnancy Project to include coverage of WIC sites. The major objectives of this project are to: Develop, field-test, and evaluate a package of smoking interventions for use with WIC participants which is compatible with both prenatal clinic and WIC program settings and develop a practitioner's guide for adapting and implementing prenatal smoking cessation efforts for WIC participants in nonstudy sites. The agreement, originally signed in 1986, is projected for completion in 1992.

- o Evaluation of the Impacts of FNS Programs on Dietary Intake Using FNS' 4-Day Files From the 1985 CSFII Survey

This ongoing project is to test state-of-the-art analytic techniques to estimate usual dietary intake and assess food stamp and WIC program impacts on individual nutrient intake. Measures of usual intake will be created with statistical procedures to create unbiased population estimates. Program impacts will be constructed using econometric modeling to control for selection bias.

### 3. Nutritional Status Assessment Research

- o Indicators of Zinc Status During Pregnancy

Dietary zinc intake, particularly by pregnant women, is substantially below the Recommended Dietary Allowance. This is of special concern because of the known deleterious effects of low Zn intake during reproduction in animals, in which Zn deficiency may result in malformed offspring and difficult delivery. Methods of identifying low Zn status in pregnant women may therefore be critical. Plasma/serum Zn concentration, the most commonly used criterion, is a poor indicator of zinc status and is particularly difficult to interpret in pregnancy. Because the pregnant guinea pig shares characteristics with the



human, it is a useful model for developing better indicators of zinc status. Three experiments were performed with guinea pigs in which Zn intake was reduced, beginning on day 30 of gestation. Abortion/premature delivery occurred in the zinc-deficient guinea pig, apparently secondary to the reduced feed intake/weight gain of deficient animals. Fetal/neonatal liver Zn concentration was low in the guinea pig compared to that reported for other animals and was affected to a lesser extent by low Zn intake of the dam. Zn concentration of neonatal plasma was also less than that in several other species. Understanding the mechanisms responsible for differences in Zn metabolism by different species will aid in predicting the effects of inadequate Zn intake in humans. Change in activity of angiotensin-converting enzyme with addition of Zn in vitro was greater in plasma of Zn-deficient than in that of Zn-adequate guinea pigs and may be useful as an indicator of Zn status.

o Iron Status Indices in Menstruating Women

Iron deficiency is the most commonly recognized nutritional deficiency in the United States. Diagnosis of pre-anemia iron deficiency is important for identification of people at risk of developing anemia and because evidence indicates that there is a relationship between low iron stores and abnormalities in behavior, immune function, and work performance. The relative sensitivities of different indices in detecting iron depletion in menstruating women, experimentally depleted of iron by phlebotomy and a low-iron diet, were found to be in decreasing order, ferritin, percent of transferrin saturation, plasma iron, hemoglobin, hematocrit, and zinc protophorphryn. Ascorbic acid treatment during repletion, prior to iron supplementation, significantly affected changes in hemoglobin, zinc protophorphryn, zinc protophorphryn/hemoglobin, and hemoglobin. Data indicate that iron stores need to be depleted before changes in heme synthesis occur and, conversely, during iron repletion hematopoiesis needs to be satisfied before iron stores, as reflected by ferritin, increase. These results indicate that the use of only one abnormal index of iron status has limited value in detecting iron depletion. Two or more abnormal indices are more predictive of iron depletion.

o Assessment of Manganese Status

As a component of several enzyme systems, manganese is considered to be an essential nutrient for all animals, including humans. However, there are no reliable methods for determining manganese nutritional status. Accordingly, a procedure to measure the manganese content of blood and blood cells was developed. About 66 percent of the manganese in blood is in the red blood cells. The "buffy coat," consisting of the platelets and leucocyte fractions, accounts for about 30 percent of the total. Because the "buffy coat" components turn over more rapidly than erythrocytes, their manganese content may be more indicative of manganese nutrition. The manganese content of these cells may be indicative of body stores and serves a useful index of manganese nutritional status.

o Improved Method for Measuring Bone Density

Dual-energy x-ray absorptiometry is a newly developed technology to assess bone mineral density. It is gradually replacing dual-photon absorptiometry in clinical research and clinical practice. The reproducibility and stability of dual-energy x-ray absorptiometry measurements were evaluated over a 9-month period. The variation in bone mineral density measurements of the spine, hip, and whole-body was approximately half that observed with the older dual-photon absorptiometry method. The amount of soft-tissue surrounding the spine was found to affect bone mineral density measurements only to a small degree. No drift in bone mineral density measurements occurred in the physiologic range of soft-tissue thickness. Therefore, it is concluded that dual-energy x-ray absorptiometry represents a major advance in bone densitometry. With this new technology, studies measuring bone loss can be effectively carried out with a smaller number of study subjects and with less scan time and less radiation exposure per subject.

## F. Food and Nutrition Information and Education Research

This research includes studies of dietary practices and food consumption patterns and their determinants (some described above), as well as studies of methods and strategies for informing and educating consumers and professionals who serve them, about nutrition, health, and dietary practices.

### 1. Establishing Dietary Guidance Policy (HNIS)

#### o Campaign Continues To Increase Public Awareness of Dietary Guidelines for Americans

"Eating Right...The Dietary Guidelines Way," the ongoing HNIS nutrition education initiative designed to increase awareness of the Dietary Guidelines and to help people put them into action, has successfully completed two major promotions and is preparing for a third. The first two featured marketing of new Dietary Guidelines-oriented materials for consumers--(1) four booklets on making everyday food decisions from planning menus to eating out and (2) a series of fact sheets on "Good Sources of Nutrients" and a newly revised publication "Calories and Weight, The USDA Pocket Guide." The third will feature results of USDA's Nationwide Food Consumption Survey as they relate to the new edition of the Dietary Guidelines for Americans.

Major campaign activities included development of two press kits issued to 3,000 large-circulation magazines and newspapers nationwide; development of a repro-booklet with camera-ready stories and graphics designed for use by 3,500 smaller newspapers nationwide; a broadcast media outreach involving nearly 75 interviews in major cities across the country, professional outreach programs for nutritionists, home economists, and health professionals; and a congressional outreach targeting each member of Congress and the Agriculture Commissioner and Governor in each State. Nearly 12 million viewers/listeners were reached in media activities. Print media efforts have resulted in over 150 articles, including features in well-known newspapers and magazines. Estimated readership reached is over 82 million. Up to 94 million consumers have therefore potentially been reached by our combined print/broadcast media efforts to date.

The professional outreach portion of the campaign has resulted in reprinting of campaign materials, development of spinoff materials such as a teaching kit for nutrition educators, nutrition-month initiatives by several States, and use of the materials in a variety of activities, e.g., client counseling, classes and workshops, supermarket tours, worksite wellness programs, and weight control groups. The campaign's outreach to professionals has fostered a number of cooperative efforts with other USDA agencies (e.g., Extension Service, Food and Nutrition Service, Food Safety and Inspection Service) and nongovernment agencies (e.g., Food Marketing Institute, American Dietetic Association).

#### o USDA's Dietary Change Research Model

Research using USDA's Dietary Change Research Model has continued. The model is designed to measure the change that would be required in food consumption patterns in the United States to meet nutritional recommendations made by authoritative groups. Research has been conducted to assess the change



required in women's diets to meet various sets of recommendations. HNIS scientists have made presentations on the model and its applications, for mutual research interests at the National Heart, Lung, and Blood Institute Workshop on Heart Healthy Diets for Older Americans and the National Nutrient Databank Conference.

- o Evaluation of Dietary Guidelines for Americans Bulletin

A nutrition education research study was conducted to determine usability and understanding of the nutrition information presented in the bulletin Dietary Guidelines for Americans. Six focus groups and indepth interviews were conducted with 90 women. The interview and focus group results showed that respondents liked the format, organization, and amount of information that was presented in the bulletin. The content they liked best was about weight and dietary fat. The content they liked least was about alcohol and starch and fiber. "Empty nest" women showed higher knowledge gain from pre- to post-test because of reading the bulletin. One conclusion drawn from the study was that the brochure may be best used to increase awareness of the Dietary Guidelines and the relationship between diet and health. Similar interviews were conducted with 45 male study participants. Analyses of these data are underway, comparing reactions of men to the Dietary Guidelines concepts with those obtained for women.

- o USDA's Food Guidance System Redesigned

A nutrition education research study to design and formatively evaluate USDA's leaflet presenting "A Pattern for Daily Food Choices" has resulted in graphic representation for the food pattern in a pyramid theme. Using results from exploratory focus groups, several prototype graphic representations of the food pattern were developed using a pyramid theme. Text for a brief booklet describing use of the food guide was developed and revised based on peer review by nutrition educators. A prototype booklet featuring the pyramid and descriptive text was prepared for evaluation by four focus groups of women and one group of men. Materials were then revised and prepared for message testing by mall intercept. Results were used in developing layout and camera-ready copy for the USDA's proposed redesigned food guide brochure.

- o Dietary Guidelines for Americans Assessed for Low-Literacy Audience

A nutrition education research study was conducted to assess format and content of Dietary Guidelines joint information for adults with low literacy skills. Adult basic education teachers and nutrition professionals who work with low-income audiences identified nutrition topics, format, and stylistic features for Dietary Guidelines materials that would appeal to adults with functional reading skills at about the 5th grade level. Information from "Dietary Guidelines and Your Diet" bulletins was adapted to a 5th-6th grade reading level in a brief booklet addressing each dietary guideline and providing tips on feeding young children and shopping for food. The prototype booklet was evaluated by 6 focus groups and 30 indepth interviews of adults who read at the 5th grade level. Reading comprehension was assessed by free recall prior to the indepth interviews. Potential usefulness of the booklet and its components was further assessed by 30 adults in brief "critical incident" interviews designed to pinpoint more specifically favorable and

unfavorable aspects of the bulletin. Content and layout of the prototype booklet were revised based on the results of these evaluations and retested in additional focus groups and indepth interviews. Results from this research are being used to determine the format and content of Dietary Guidelines print information being developed for adults with low literacy skills.

## 2. Food and Nutrition Materials and Methods

Most materials developed in 1990 interpret concepts in the Dietary Guidelines and results from USDA research on food composition, food selection, handling and storage, and food money management. Target audiences are food and nutrition professionals, such as home economics teachers, Extension agents, public health professionals who work with the general public, low-income groups, and consumers with special interest in food and nutrition. The following are materials developed and/or released in 1990.

### o Factsheets on Good Sources of Nutrients

A series of 17 factsheets was published to provide information to help people select foods that contain adequate amounts of vitamins, minerals, and dietary fiber as they follow the Dietary Guidelines for Americans. A separate factsheet is provided for each nutrient. Each factsheet includes information on the function and food sources of the nutrient and tips on how to prepare and serve foods that are good sources of nutrients.

### o Calories and Weight

"Calories and Weight, The USDA Pocket Guide" was revised. This handy pocket-sized guide provides consumers with the calorie content of nearly 400 foods in an easy-to-read format. It includes helpful information to use when following a weight-loss diet, on maintaining desirable weight, and the importance of calorie control.

### o Dietary Guidelines Teacher's Guide for Health Education Teachers

A teacher's guide for health education teachers in junior and senior high schools is being developed based on the 1990 Dietary Guidelines for Americans. An experienced author of nutrition education materials developed lesson plans and learning activities for the guide. An advisory panel of health education teachers provided content ideas, and a number of nutrition and/or health education specialists reviewed the materials. The guide will be distributed as a joint effort of HNIS and the Association for the Advancement of Health Education in conjunction with a special edition of their journal that will be devoted to nutrition.

### o Dietary Guidelines Factsheets for Healthy Older Americans

A brief factsheet series for healthy older adults on using the Dietary Guidelines for Americans is being developed as a cooperative project with the National Institute on Aging. An advisory panel of professionals who work with the independent elderly, a writer of health information for older adults, and a focus group moderator are participating in the project. The writer used information from the advisory panel to adapt portions of HNIS bulletins on the



Dietary Guidelines for the elderly audience. Draft materials have been peer-reviewed by nutrition educators and evaluated by target audience participants.

- o USDA's Dietary Analysis Program

USDA's Dietary Analysis Program (DAP), developed by HNIS in cooperation with the Extension Service for use by consumers to assess the nutrient content of their diet, was updated to include the most current nutrient data and the 1989 Recommended Dietary Allowances. USDA's DAP software is available to the public from the National Technical Information Service and on the HNIS Nutrient Databank Bulletin Board. Work is in progress to convert the software to APPLE format so that the program can be used by schools for health and nutrition education programs.

- o Cost of Food

The cost of food at home in food plans at four cost levels--thrifty, low-cost, moderate-cost, and liberal--was estimated and released monthly in press releases and other formats. The cost of food in the thrifty food plan for the 4-person household, which is used by the Department in setting benefits for the Food Stamp Program, increased 5.4 percent between June 1989 and June 1990.

- o A Study of Appropriate Methods of Drug Abuse Education in the WIC Program

Public Law 100-690, the Anti-Drug Abuse Act of 1988, directed USDA to conduct a study of appropriate methods of drug abuse education for WIC participants; prepare drug abuse education materials and distribute them to WIC State agencies; and appoint two experts in drug and alcohol abuse education and prevention to the National Advisory Council (NAC) on Maternal, Infant, and Fetal Nutrition.

A contract to conduct the study and develop a resource manual for WIC local agency professionals was awarded in March 1989. The study report was issued to Congress in January 1990; the manual should be available in Fiscal Year 1991. Based upon this study's recommendations, FNS is developing a videotape, pamphlet, and poster to warn WIC participants about the dangers of drug use during pregnancy and lactation and a videotape to train WIC local agency professionals on screening and making referrals for abuse assessment. Two experts in drug and alcohol abuse education and prevention were appointed to the NAC and attended the Council's August 1990 meeting.

- o Breastfeeding Promotion Study and Demonstration

The fourth and final phase of this study was completed in Fiscal Year 1990, with the final report published in the fall of 1990. The overall project goal was to assist State and local agencies in their efforts to increase breastfeeding incidence and duration among WIC women by identifying, evaluating, and demonstrating educational models for effective breastfeeding promotion. Information on breastfeeding promotion approaches used in WIC was collected and analyzed during Phases I-III. Phase IV involved a demonstration during which selected approaches were implemented at seven WIC local agencies. Results of the demonstration indicated that both incidence and duration of breastfeeding were increased in the intervention sample. Based on



the demonstration, seven key elements of an effective breastfeeding promotion and support program were identified.

- o Dietary Assessment Methodology

The Food and Nutrition Service (FNS) entered into a cooperative agreement with the Harvard School of Public Health (HSPH) in Fiscal Year 1990 for development of two dietary screening instruments to be used in the WIC Program. The agreement calls for modification and expansion of a prenatal dietary assessment tool previously developed under a Special Project of Regional and National Significance (SPRANS) Grant funded by the U.S. Department of Health and Human Services (DHHS). Additional research is required to expand its screening capability to include all women, postpartum (lactating and nonlactating) as well as pregnant women, and to allow for development of a comparable tool for screening children 1-5 years of age. Field observations of the instruments in WIC clinics will be required to assess appropriateness of the food listings and ease of participant self-administration. A method of manual scoring of instruments will be derived in addition to further development of the computer analysis program.

- o Wayne County, Michigan, Health Clinic Smoking Reduction Project

This project will evaluate two specific smoking reduction methods in a high-risk population of women of childbearing age. Wayne County, Michigan, has one of the highest infant mortality rates in the Nation. Participating WIC and non-WIC women are included in the study. A practitioner's guide on how to implement a smoking cessation program will be developed. The expected completion date was September 1990.

- o Nutrition and Family Interaction

The context for family interaction related to food and nutrition was studied using a data set of 501 families with young children and from indepth qualitative interviews. In terms of context, that is situations in which family interaction could occur, it was found that, for upstate New York families with elementary school children, 47.5 percent of the mothers and 29.6 percent of the fathers reported eating breakfast with their children at least half the time. For dinner 95.3 percent of mothers and 82 percent of fathers almost always ate with their children. Twenty percent of the fathers reported being involved in family food selection and preparation at least half the time, while half the fathers reported significant involvement. Significant correlations were found between the fathers and children for nutrition knowledge, their food-like score, the variety of foods they reported having tasted and their snack quality scores. For mothers, these correlations were significant only for nutrition knowledge and snack scores. Both men and women identified family food preferences as a major constraint on their family food choices. Both spouses agreed that dietary changes were a lot easier when family members liked the taste of "healthy" foods.

- o Computerized Dietary Analysis as an Educational Tool

Extension Service and the Human Nutrition Information Service have completed a joint project to evaluate the cooperatively developed USDA's Dietary Analysis Program (DAP). USDA's DAP is a software package that analyzes dietary intakes

for up to 3 days and provides information on 28 nutrients and food components. The nutrients data base used by the software consists of the 850 most commonly consumed foods from HNIS' most up-to-date available nutrient values--the USDA Nutrient Data Base for the 1987/88 Nationwide Food Consumption Survey. This data base can be updated as the nutrient values change, adding a dimension of accuracy not common to other dietary analysis software packages.

The evaluation found the USDA DAP to be an extremely valuable, effective teaching tool that can be used in a variety of Extension settings.

o Food Safety Public Awareness Strategies Explored

In cooperation with the Food Safety and Inspection Service, Extension Service has just completed the development and evaluation of various strategies to communicate basic concepts of food safety through public media. The project looked specifically at use of agricultural chemicals and the impact they have on the food system.

The evaluation was conducted by Colorado State University. The investigation team used focus group interviews in Colorado and across the United States to develop public media messages and then to evaluate their impact. The study found that media messages need to be segmented according to audience type and media market. Another major finding was that although food safety messages do elevate concern, they also increase understanding and a sense of control.

## G. Food Marketing and Demand

### 1. Studies on Food Supplies, Prices, Expenditures, Marketing Costs, Safety, Technology, and Consumer Demand

ERS' National Food Review: A Decade in Review (NFR 1990 Yearbook issue, Volume 13, Issue 3, July-September 1990) reviewed the trends of the last decade in U.S. per capita food availability, food prices, food expenditures, and domestic and overseas food assistance programs.

#### o U.S. Food Supply Trends

The U.S. food supply data series was updated in FY-90 in Food Consumption, Prices, and Expenditures, 1967-88 (FCPE), Statistical Bulletin 804, May 1990. FCPE is an annual publication.

#### o Garlic, Eggplant, Artichokes, and Watermelon

Garlic, eggplant, and artichokes were returned to the fresh per capita series in FY-90. These vegetables were dropped from the series in 1982 because of cutbacks in the National Agricultural Statistics Service's budget for collection of production statistics. The new estimates use data reported by the State departments of agriculture in their annual reports and from the California County Agricultural Commissioners' reports. Watermelon estimates, also dropped in 1982, were developed through a special research study and reported in The U.S. Watermelon Industry (by Amy J. Allred and Gary Lucier, ERS, USDA, Staff Report No. AGES 9015, March 1990). The report indicates that watermelon production and utilization declined from 1960 to 1980. However, recent evidence indicates that since 1980 both aggregate production and domestic utilization have expanded. This study reviews supply and utilization trends, prices, transportation, packaging, marketing, cash receipts, and costs of producing watermelons. It also documents historical industry changes and reviews the research and promotion program enacted by the industry in April 1989.

#### o New Procedure Estimates Per Capita Utilization of Processed Apples and Pineapples

Per capita consumption estimates for processed apple and pineapple products have not been available since the two industries ceased disclosure of pack and stock data early in the 1980's. However, it is possible to approximate the trend and general level of consumption over time by using crop utilization data published by USDA, adjusted by imports and exports. ERS introduced its new per capita utilization series for processed apples and pineapples in the Fruit and Tree Nuts Situation and Outlook Report Yearbook (TFS-254, August 1990). The user is cautioned against interpreting these numbers as reflecting actual year-to-year changes in consumption (food disappearance), because the data do not reflect year-to-year changes in stocks and, thus, can be highly variable between years.

In general, utilization data for apples (adjusted for imports and exports) indicate that U.S. per capita consumption of fresh and processed apples has trended upward since 1970/71 (beginning of data series), but consumption remains highly variable across products. While per capita canned apple



consumption has remained fairly flat over the past 20 years, per capita consumption of apple juice has dramatically increased, surpassing (on a fresh weight basis) fresh apple consumption in at least 1 year. In 1989, apple juice (fresh weight basis) accounted for 40 percent of total U.S. apple consumption, at 19.0 pounds per person, compared with only 20 percent in 1970.

The utilization data for pineapples (adjusted for U.S. imports and exports) suggest that U.S. per capita pineapple consumption has been steady over the past 20 years. While U.S. consumers use considerably more processed pineapple than fresh, shifts in consumer demand between processed pineapple forms are not readily evident from this data series, as pineapple utilization data for processing are not available for canned pineapple or pineapple juice.

- o Industry Request for Revision of Raisin Consumption Estimates Prompts Similar Revision of Olive Consumption Estimates

In May 1990, the Raisin Administrative Committee (RAC) in Fresno, CA requested a re-examination of USDA procedures for estimating per capita raisin consumption. Working with RAC, ERS did establish new estimation procedures, and published revised estimates for raisins in the Fruit and Tree Nut Situation and Outlook Yearbook (ERS, USDA, TFS-254, August 1990). Similarly, cooperation with the California Olive Committee led to revised USDA estimates of per capita fresh olive utilization, also introduced in the 1990 yearbook.

- o USDA Meat Consumption (Disappearance) Series Revisions

USDA is currently revising its red meat and poultry consumption series to reflect changes in marketing practices and to facilitate comparisons of red meats, poultry, and fish and shellfish. USDA has several meat and poultry consumption series, depending on the amount of bone and internal organs removed. Consumption of red meat is reported on carcass, retail, and boneless, trimmed weight bases. Chicken and turkey consumption is reported as ready-to-cook (RTC) and boneless. The National Marine Fisheries Service similarly reports an edible-weight or boneless-weight series for fish and shellfish. The boneless, trimmed series are a close measure of the amount Americans have available for consumption but should not be equated with the amount actually eaten. Significant losses occur in home preparation and consumption, including trimming, cooking, and disposal of uneaten portions (including that fed to pets).

The basic measurement of beef consumption is made at the primary distribution level, or slaughter plant, on a carcass-weight basis. Conversion factors are used to calculate estimates of the portion of a beef carcass that is purchased by consumers and the boneless equivalent of this beef purchased. In 1989, for example, ERS estimated that 70.5 percent of the beef carcass was processed into products suitable for sale in grocery stores (retail weight). The conversion factor had remained at 74 percent from 1962 through 1985. Changes in beef production and processing, however, have prompted annual adjustments in the factor since 1986. The revised figures account for leaner cattle, closer trimming of fat, and removal of more bone. The lower conversion factor means that 3.6 pounds less beef per capita were purchased in 1988 than if the 1962-85 factor were used. Exterior fat trimmed from beef cuts before retail sale accounted for 2.2 pounds of the difference, less bone amounted to 1 pound, and less fat in hamburger and processed meat, to 0.4 pound. It is not

clear how these changes affect the amount of beef fat actually ingested. In earlier years, consumers may have trimmed much of the beef fat now being removed by meatpackers and food distributors.

ERS decided after careful study to revise the retail and boneless, trimmed equivalent pork consumption series back to 1955, because the conversion factors in use did not fully reflect changes resulting from the production of leaner hogs and changes in merchandising practices over the past 35 years. Results of the study indicated that pork consumption on a retail weight basis has been somewhat overstated in recent years, and boneless, trimmed weight somewhat understated. The revised data appear in "Revisions in Conversion Factors for Pork Consumption Series" in the January 1991 Livestock and Poultry Situation and Outlook Report (ERS, USDA, LPS-45).

Re-examination of the poultry consumption series also began in FY-90. The RTC series will likely be adjusted to make it more comparable to the red meat carcass-weight series, and a new retail-weight poultry series that reflects trends in merchandising practices, including the increasing availability of boneless and skinless poultry, will likely be created. Plans also call for estimating the quantity of poultry used in the pet food industry; currently, per capita food consumption estimates include the poultry that is used in commercial feeds. Look for the new poultry data series in mid-1991.

- o Initiatives To Estimate Consumption of High-Intensity Sweeteners

The potential exists over the next decade for a reduction in the use of sugar and corn sweeteners as alternative high-intensity sweeteners are increasingly available as substitutes at competitive prices. Food processors could also adopt a multisweetener policy. Increasingly, both caloric and low-calorie sweeteners are likely to be combined to obtain an optimal mix in terms of price and functional factors such as sweetness, taste, texture, and stability. Moreover, interest in "light" foods appears to be growing rapidly, and low-calorie alternatives are well positioned to capture the growth. Currently, USDA has no formalized system of tracking growth in this industry. Because of the growing importance of such products, ERS began in FY 90 to develop strategies and methodologies to produce consumption estimates and analysis.

- o Food Deficits in Developing Countries

Food deficits in many developing countries have grown despite decades of assistance. For about 50 developing countries, USDA has quantified shortfalls from recent status quo food supplies and also from minimum per capita caloric requirements. The status quo deficits represent estimated shortfalls from average national per capita availabilities in recent years. The nutrition-based deficits represent estimated shortfalls from minimum caloric requirements recommended by the UN Food and Agricultural Organization (FAO) and the World Health Organization (WHO). Deficits take into account estimates of local production and the country's ability to pay for commercial imports. Both types of deficit calculations include an adjustment either to increase or to draw down stocks, maintaining historical stocks-to-use relationships. Data and analysis appear in "Food Deficits Still Big," Agricultural Outlook (ERS, USDA, AO-163, May 1990).



- o Is the World Facing a Food Crisis?

The National Food Review: Feeding the World: the 1990's and Beyond (ERS, USDA, Volume 13, Issue 2, April-June 1990) focuses on world food consumption trends. In 1985, at the height of the African famine, only a few people voiced concern about the adequacy of the world's food supply. Now, without a major crisis, many--including environmentalists, economists, and policymakers--believe a world food shortage is looming. Some developing countries are unable to maintain adequate food supplies through either production or commercial imports. Therefore, they need aid from overseas to meet their food deficits. Why are these countries short of food? Do the current disturbances in world food markets foretell a crisis in world agriculture in the next few decades? Recent ERS analyses yield some disquieting observations. Government and public institutions will be influential in determining how adequate the world's food supply will be in coming years.

- o The USSR's Longstanding and Complex Food Problem

Controlled retail pricing, combined with rising incomes, is fueling food shortages in the USSR. For further information, see National Food Review, "The Soviet Food Complex in a Time of Change" (Kenneth Gray, ERS, USDA, Vol. 12, Issue 4, Oct.-Dec. 1989, pp. 19-25).

- o Food Prices

ERS forecasts the Consumer Price Index for all food, food away from home, and food at home, including 16 subaggregates of food at home. An annual forecast is released in late November each year at the National Agricultural Outlook Conference. Updates appear in Agricultural Outlook (ERS, USDA, monthly).

- o Food Expenditures in United States

ERS prepares annual statistics of total dollar expenditures for food at home and away from home. These figures include all food, regardless of who pays for it. Total food expenditures are further broken down into the share paid for by families and individuals and those paid for by governments and businesses. Annual statistics are published in Food Consumption, Prices, and Expenditures and monthly figures in Agricultural Outlook, both published by ERS.

- o Food Spending in American Households

ERS updated research on the frequency of purchase of selected foods and changing patterns of household food expenditures to obtain a consistent data series for 1980 to 1986. Average weekly food expenditures in urban households rose from \$18.94 per person in 1980 to \$23.92 in 1986. Weekly spending per person for food consumed at home increased from \$12.82 to \$14.90 and from \$6.11 to \$9.03 for food consumed away from home. Total food spending was about the same after adjusting for rising prices. This was published in Food Spending in American Households, 1980 to 1986 (ERS, USDA, Statistical Bulletin No. 791, March 1990).



- o Food Spending as an Indicator of an Affluent Society With Dual-Worker Households

The percentage of income spent for food is a much-used indicator of the affluence of the general economy. Since income generally rises faster than food expenditures, the figure has been declining for years. Sometimes it has been cited as an indicator that food is a bargain, but it provides no evidence on that point. Food expenditures have risen in almost every year since the Great Depression. But income rose faster, so food as a percentage of income has declined. Consumers have been putting more of their income into other uses and a smaller share into food. More and more food is being consumed away from home. Since prices and margins are substantially higher for restaurant meals and snacks than for food in the grocery store, the increases in away-from-home eating tend to raise the food share of income. The rapid increase in dual-earner families has also contributed to increased eating out, both lunches for the workers and dinners for the family. In a forthcoming report, ERS' Alden Manchester explores these phenomena and measures of income-food spending relationships.

- o Control of Foodborne Pathogens in Microwave-Heated Foods

A cooperative project with Pennsylvania State University was initiated to develop practical controls of foodborne pathogens contained in microwave-heated foods. Initial results indicate that pH of the material being treated drastically influences survival of thermally stressed organisms in model systems. Other variables in the study will include determining the effect of varying the wattage on destruction of Salmonella, the effect of postheating holding time, the effect of the container type, (e.g., glass vs. plastic, square vs. round), volume of food heated, and the effect of oven size (cavity size/wattage). The research will be conducted initially on model systems and then on real food systems.

- o Food Shares Between the At-Home and Away-From-Home Markets

For a variety of reasons including high incomes and more working women, the share of total food expenditures spent for food eaten away from home has been increasing. Expenditures for food away from home are approaching 50 percent of total food expenditures and the associated quantity of food consumed is approaching 35 percent of the total. No recent public data on food quantities, prices, or expenditures for individual foods exist for the away-from-home market. Knowledge of the kinds and quantities of foods used by the food service industry is critical for accurate assessment of the impacts of Government policies and programs including nutritional efforts. ERS has begun a project to estimate the amounts eaten by Americans at home and away from home for different foods. ERS plans to use the individual intake portion of the 1987-88 NFCS to calculate food consumption by sources for selected commodities and foods. These calculations will be compared with a similar analysis of the 1977-78 NFCS data.

- o World Food Expenditures

ERS periodically publishes a table that compares average expenditures for food and alcoholic beverages to be consumed at home in selected countries. The data are compiled by ERS mainly from data provided by the United Nations (UN)

System of National Accounts. Expenditure data for the USSR, Eastern Europe, and China are collected from the statistical yearbooks for those countries and interpreted by ERS. Americans do not have the highest per capita income (the Swiss do); yet, in relation to total per capita personal consumption expenditures, Americans spend the least on food. Other factors besides income influence food expenditures in developed nations. Thanks to abundant arable land and a varied climate, Americans do not have to rely as heavily on imported foods as some other nations. The American farm-to-consumer distribution system is highly successful at moving large amounts of perishable food over long distances with a minimum of spoilage or delay. Finally, American farmers have a tremendous wealth of agricultural information and state-of-the-art farming equipment at their disposal, allowing them to produce food efficiently. For further analysis, see Food Consumption, Prices, and Expenditures, 1967-88 (ERS, USDA, SB-804, May 1990) and "World Food Expenditures," National Food Review (ERS, USDA, Oct.-Dec. 1989, pp. 26-29).

- o Food Cost Indices

ERS conducted research on estimating cost-of-food indices, which recognize that consumers can substitute foods as prices change, so-called "true" cost-of-food indices, from a system of Engel curves. Estimated true-cost-of-food indices indicate that over the 1980-85 period, households that budgeted a greater percentage of their food budget to food away from home experienced more rapidly rising food costs. Since there is a strong correlation between income and spending on food away from home, this implies that food costs rose more for higher income households than their lower income counterparts. In addition, our food indices indicate that total food costs rose less for larger households than for their smaller counterparts. Food costs rose more slowly for non-European-American households than European-American households, and households in the Northeast had lower food cost inflation than other regions while the West had the highest. However, most of the calculated true-food-cost indices produced values fairly close to the CPI for total food.

- o Food Marketing Costs

How much are food costs changing? Why? How much of the consumer food dollar goes to the farmer and how much to food processors and marketers? How have recent developments affected food industry costs, profit margins, and productivity. ERS' annual Food Cost Review brings you up to date on the answers, focusing on developments during the previous year (ERS, USDA, Agricultural Economic Report No. 636, July 1990).

- o The Food Industry

Conditions in the U.S. food marketing system improved in 1989. Sales rose to an estimated \$694 billion. Competition among manufacturers for scarce shelf space in retail food stores continued strongly. The food marketing system introduced 12,000 new grocery products in 1989, but food processors cut down on direct consumer advertising. Food processors' and retailers' debt rose by nearly \$70 billion in 1989, largely due to the financing of massive leveraged buyouts and mergers announced in 1988. However, merger activity slowed in 1989. After-tax profits for food processors fell sharply due to higher interest payments. The balance of trade deficit in the U.S. processed food sector declined from \$2.7 billion to \$2.3 billion, reflecting strong export

demand in 1989. ERS prepares an annual assessment of changes in the size, structure, conduct, and performance of the 400,000 food processors, wholesalers, retailers, and restaurateurs who market the U.S. food supply. The latest is published in the Food Marketing Review, 1989-90 (ERS, USDA, Agricultural Economic Report No. 639, November 1990).

o Advertising and Demand for Cheese

ERS conducted research on the effects of advertising and promotion on the demand for cheese. During the 56-month period between September 1984 and June 1989, increased generic advertising by the National Dairy Promotion and Research Board and regional organizations of \$224.3 million increased national at-home consumption of natural cheese by 21.2 million pounds and processed by 192.5 million pounds.

o The Market for New Fat Substitutes

Growing consumer concerns about dietary fat, cholesterol, and calories have provided an economic incentive for food processors to develop new products and technologies that lower the amounts of these attributes in processed foods. Grocery store shelves are filled with reduced-fat versions of traditional foods. One company is selling a fat-free "ice cream" which contains simplesse, a protein-based fat substitute. ERS analyzed the potential market for fat substitutes in the fats and oils and dairy products markets. ERS found that the market for fat substitutes for these two food groups could reach 16.2 billion pounds annually. How much of a market fat substitutes will claim depends on FDA approval, the substitutes' quality and versatility, strength of consumer demand and willingness to pay for reduced-fat products, and marketing strategies. For further information, see "The Market for Fat Substitutes" (by R. Morrison) in the National Food Review (Vol. 13, Issue 2, April-June 1990, pp. 24-30). The article also discusses some of the nutritional concerns, regulatory issues, and intercommodity effects of widespread use of fat substitutes.



## H. Research on Government Policies and Socioeconomic Factors

### 1. Studies on Food Safety and Consumer Demand

#### o Diet/Health Awareness and Fat Intakes

ERS conducted research to assess the effects of diet/health awareness on actual fat intake and dietary sources of fat. Based on individual food intake data on women ages 19-50 years in 1977 and 1985, the results suggest that women with better access to nutrition information significantly altered the relative importance of different food groups in providing dietary fat between 1977 and 1985. However, these women did not exhibit a comparatively greater reduction in overall fat intake. For further information, see "Assessing the Effects of Diet/Health Awareness on the Consumption and Composition of Fat Intake" (by D.S. Putler and E. Frazao) in The Economics of Food Safety (Edited by Julie A. Caswell. New York: Elsevier Science Publishing Company, Inc., Forthcoming 1991). This research is summarized in Farmline, ERS, USDA, Vol. XI, No. 9, Sept. 1990.

#### o Issues Behind Mandatory Seafood Inspection

Rapidly rising per capita consumption of seafood and a renewed emphasis on water quality have aroused concern over whether fish and shellfish in the United States are safe to eat. Highly publicized incidents in recent years, such as contamination of coastal waters in the Northeast by medical wastes, disease outbreaks among crabs and oysters in the Chesapeake Bay, and red tide contamination in the Carolinas, have led to calls for mandatory Federal inspection. The seafood industry is basically not averse to mandatory inspections. However, the industry is concerned with the method and cost of inspections and the adverse publicity generated by consumer groups. Although no single, mandatory program exists, many State and Federal agencies inspect seafood. For further information, see "Issues Behind Mandatory Seafood Inspection" (by D. Harvey) in the National Food Review (ERS, USDA, Vol. 12, Issue 4, Oct-Dec 1989, pp. 30-33).

#### o Food Safety Economics

ERS conducted economic research on numerous food safety issues, including the costs of foodborne microbial diseases. These studies found that estimates of medical and lost productivity costs from bacterial foodborne illness were about \$4.8 billion in 1987. ERS is collaborating with epidemiologists and food scientists to refine estimates of human illnesses associated with specific pathogens, determine the distribution of illness severities, and, where possible, estimate long-term complications. For further information, see "Risk Assessment for Estimating the Economic Costs of Foodborne Disease Caused by Microorganisms" (by T. Roberts and P. M. Foegeding) in Economics of Food Safety (Edited by Julie A. Caswell. New York: Elsevier Science Publishing Company, Inc., Forthcoming 1991). Also, see "Human Illness Costs of Foodborne Bacteria" (by Tanya Roberts) in the American Journal of Agricultural Economics (Vol. 71, No. 2, May 1989, pp. 468-474).

## o Modernizing Wholesale Food Marketing Facilities

An efficient wholesale food marketing system improves the quality and variety of products available to consumers. It helps minimize food marketing costs, holds down food costs to consumers, and makes it possible for farmers to obtain more of the food dollar for their products.

In cooperation with local governments and the food industry, AMS conducts research to improve this system. Studies look at revitalizing existing facilities that are obsolete, relocating facilities forced to move because of urban development, and developing new facilities in areas where existing facilities are inadequate. The needs of an area are analyzed, new systems and conceptual building designs are proposed, and the costs and potential benefits are estimated.

The results of two new AMS studies were published in 1990. One study recommended marketing facilities to help address a concern of southwestern Michigan produce leaders--how to increase the State's production of fresh fruits and vegetables, which are currently decreasing or stable, to match the increasing consumer demand for these items. The other study was limited to a general survey of meat firms in the West Harlem-Hudson Piers area of New York City--an area targeted for major redevelopment--and the relocation of these firms to the existing Hunts Point Food Distribution Center.

Two earlier studies have culminated in the construction of new and improved wholesaling facilities. A new wholesale food center and farmers' market in Raleigh, North Carolina, to serve 24 counties in the central part of the State, had its first occupants in 1990. A large public refrigerated warehouse was finished in 1990, and plans are complete for other phases of the revitalization of wholesale facilities to serve Syracuse, New York, and the surrounding seven counties.

## 2. Socioeconomic Programs

### o Impact Evaluation of WIC Farmers' Market Coupon Demonstration Projects

The general objective of this evaluation is to assess the impact of 10 farmers' market demonstration projects. It will examine their effectiveness in accomplishing the legislative goals of: (1) providing fresh foods from farmers' markets to WIC participants; and (2) expanding the awareness and use of farmers' markets. This will be accomplished largely through surveys to measure the food consumption and purchase patterns of WIC coupon recipients and sales and food purchases at participating farmers' markets as compared to appropriate control groups. The results of this study and the Process Evaluation of the Farmers' Market Projects will form the basis of a report which was due to Congress by April 1991.

### o WIC - 1988 National Maternal and Infant Health Survey

FNS is one of several Federal agencies participating in a health data collection effort by the National Center for Health Statistics. The major areas of investigation include low birthweight and infant mortality; barriers

to and facilitators of prenatal care; the effects of substance use on pregnancy outcome; the effects of sexually transmitted diseases (including AIDS) on pregnancy outcome; and use and evaluation of public programs, such as WIC, by mothers and infants. The inclusion of WIC questions in the survey is expected to provide data on WIC services and outcomes in the context of other health and medical information covering most of the nutritional risk conditions for high-priority WIC eligibility during pregnancy. The project is expected to be completed by summer 1991.

- o A Study of Savings in Medicaid and Indigent Care for Newborns From Prenatal Participation in the WIC Program

This study assesses the savings in Medicaid and indigent care costs for women and their newborns in the first 60 days after birth resulting from the mother's prenatal participation in the WIC Program. A report of the results of this study was submitted to Congress on October 1, 1990. Volume 2 (forthcoming) will discuss technical issues and alternative model specifications.

- o WIC Dynamics Study

Increased participation brought on by rebates and more funding, along with other changes, have affected the dynamics of local WIC agency operations. This study will describe the effects of such changes on service to participants and on those who operate the WIC Program. Areas of key interest include the impacts on health care referrals and other links to the medical community and the current status of nutrition education. An understanding of challenges to program integrity, opportunities for greater effectiveness, and participant responses to new conditions is necessary for future program planning and budgeting.

- o Evaluation of the Alabama Pure Cash-Out Demonstration, Evaluation of the San Diego Cash-Out Demonstration, and Evaluation of the Washington State Family Independence Program

The major focus of these three evaluations is on the effects of issuing food benefits in the form of cash on recipient household expenditures, food expenditures, food use, and nutritional availability.

### 3. Highlights

- o FNS Elderly Feeding Study

The purpose of this study was to: (1) identify and describe the characteristics and nutritional needs of the low-income elderly, including projected trends, (2) describe the key features of the USDA programs that provide food assistance to the elderly, (3) identify and describe the types of elderly being served by these nutrition assistance programs, and (4) evaluate how well the needs of the elderly are being served by USDA food assistance programs, according to the perceptions of elderly persons and others.

The final report of this study, completed in July 1990, indicates that the needs and circumstances, i.e., income and family size, of low-income elderly vary widely within the population as does the scope of feeding programs



available to them. In addition, the study indicated that nonparticipation in FNS elderly feeding programs is due to the fact that potential participants, eligible for small benefits, view the benefits (e.g., food stamps) as minimal compared to the effort necessary to seek such benefits. The size and weight of commodity foods provided through the Temporary Emergency Food Assistance Program and the Commodity Supplemental Food Program were also cited as a deterrent to participation in these programs.

- o Evaluation of the Food Distribution Program on Indian Reservations

This evaluation study examined the operations and effectiveness of the Food Distribution Program on Indian Reservations (FDPIR). A nationally representative sample of participating households was interviewed regarding their use of and preferences for commodity foods distributed, adequacy of household food supply, and nutrition-related health problems. Findings of the evaluation were:

88 percent of the FDPIR households reported they had enough to eat.

FDPIR food package was rated as acceptable to the majority of households.

Program staff and recipients reported a need for more nutrition education.

- o Reimbursement of Fourth Meals in the Child Care and Adult Food Program (CACFP) in Minnesota

Public Law 100-435 mandated this demonstration. A preliminary report submitted to Congress in January 1990 showed that the fourth meal was not an incentive to increasing CACFP participation. A substantial number of meals were served, but not claimed for CACFP reimbursement in family day care homes both before and during the demonstration. Nearly all of the fourth meals which were reimbursed in homes and in centers under the demonstration were snacks. Final participation rates and the relative frequency of foods served in these snacks will be reported in a final report to Congress.

### III. NUTRITION EDUCATION AND INFORMATION PROGRAMS

The Human Nutrition Information Service coordinates Federal dietary guidance policy, develops research-based dietary guidance materials for the general public, and reports results from its research in food composition, food consumption, and nutrition education to professionals.

#### A. USDA's Responsibility To Ensure That the Federal Government "Speaks With One Voice" When Issuing Dietary Guidance

##### 1. New Dietary Guidelines Released

The third edition of "Nutrition and Your Health: Dietary Guidelines for Americans" was released jointly by USDA and DHHS in November 1990. The Dietary Guidelines for Americans are the Federal Government's policy for nutritional advice to healthy Americans. The new Dietary Guidelines reflect the recommendations of the Federal Dietary Guidelines Advisory Committee. The Committee, established by USDA and DHHS in 1989 to review recent scientific evidence on diet/health relationships and recommend revision of the 1985 edition of the Dietary Guidelines, was composed of nine nationally recognized nutrition scientists and physicians. HNIS provided staff support for the Committee, which advised the two Departments on revisions to be made in the Dietary Guidelines in a 50-page Committee report entitled "Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 1990." The third edition maintains the seven principal messages of earlier published guidelines (1980 and 1985). The new bulletin, however, reflects changed emphasis to take into consideration the latest scientific information. The bulletin's presentation is clearer and more diet-oriented than previous editions and includes a new and interim approach to judging the appropriateness of one's weight. It also for the first time contains suggested numerical limits for fats and saturated fat intake and short action statements ("advice for today") along with each guideline.

The 1990 guidelines detail the following main points:

- o Eat a variety of foods
- o Maintain healthy weight
- o Choose a diet low in fat, saturated fat, and cholesterol
- o Choose a diet with plenty of vegetables, fruits, and grain products
- o Use sugars only in moderation
- o Use salt and sodium only in moderation
- o If you drink alcoholic beverages, do so in moderation

The bulletin is available to the public without charge. To get a single free copy, write to: Consumer Information Center, Department 514-X, Pueblo, CO 81009.

##### 2. Promotion of the Guidelines

HNIS is continuing the consumer nutrition education campaign called "Eating Right...The Dietary Guidelines Way." The initiative, designed to increase awareness of the Dietary Guidelines and to help people put them into action, has successfully completed two major promotions and is preparing for a third.

The first two featured marketing of new Dietary Guidelines-oriented materials for consumers--(1) four booklets on making everyday food decisions from planning menus to eating out and (2) a series of factsheets on "Good Sources of Nutrients" and a newly revised publication "Calories and Weight, The USDA Pocket Guide." The third will feature results of USDA's Nationwide Food Consumption Surveys and Diet and Health Knowledge Survey as they relate to the new Third Edition of the Dietary Guidelines for Americans.

### 3. Uniformity Within USDA

The Dietary Guidance Working Group of the Subcommittee for Human Nutrition, initiated in 1986, continues to review all USDA publications and materials that contain dietary guidance information to help ensure (1) that they accurately reflect USDA's food and nutrition policy as presented in the Dietary Guidelines for Americans and in the Secretary's Statement of USDA's Food and Nutrition Policy, (2) that they are supported by research-based knowledge, (3) that they are objective in presentation, and (4) that they are supported across all agencies of USDA. The group is chaired by HNIS and includes representatives from 10 other USDA agencies--AMS, ARS, CSRS, ERS, ES, FNIC, FNS, FSIS, HNIS, and OGPA--and a liaison member from the DHHS. The group also serves as a means of communication among nutrition education specialists in the USDA agencies that provide guidance to their respective clientele.

### 4. Uniformity Among Departments

The Department continues to work with other agencies, especially DHHS, in promoting uniformity of dietary guidance messages. For example, on behalf of USDA, HNIS coordinated with DHHS all activities of the Federal Dietary Guidelines Advisory Committee, the review of Committee recommendations in the two Departments, and the development of final text for the third edition of the Dietary Guidelines for Americans. HNIS is represented on a DHHS Subcommittee on Dietary Guidance; on the Coordinating Committee for the National Cholesterol Education Program sponsored by the National Heart, Lung, and Blood Institute; and on the Nutrition Objectives Working Group of the DHHS Year 2000 Health Objectives. HNIS and DHHS' National Institute on Aging are working jointly to develop a factsheet series for healthy older adults on using the Dietary Guidelines.



## B. Programs Initiated or Expanded

### 1. Extension's Expanded Food and Nutrition Education Program (EFNEP)

#### a. General

The Expanded Food and Nutrition Education Program (EFNEP) operates in all 50 States and in American Samoa, Guam, Micronesia, Northern Marianas, Puerto Rico, and the Virgin Islands. Extension professionals train and supervise paraprofessionals and volunteers who teach food and nutrition information and skills to low-income families and youth.

The objectives of the Expanded Food and Nutrition Education Program are to assist low-income families and youth in acquiring the knowledge, skills, attitudes, and changed behavior necessary for nutritionally sound diets, and to contribute to their personal development and the improvement of the total family diet and nutritional well-being.

In FY '89, 201,807 families were enrolled in EFNEP compared to 187,260 in FY '88. This is a 7.8-percent increase over FY '88. In FY '89, 413,832 youth were enrolled in the 4-H EFNEP compared to 369,658 in FY '88. This is an 11.9 percent increase over FY '88. Overall there were 615,693 adult and youth participants enrolled in EFNEP in FY '89, an increase over FY '88 of 10.5 percent.

Participants were reached by direct teaching contacts with 2,125.2 full-time equivalent (FTE) paraprofessionals, supervised by 361.2 FTE professionals. This represents an increase of 13.3 participants per FTE paraprofessional over 1988 levels. In addition, 50,760 volunteers worked 599,388 hours (FTE of 287). At a minimum dollar value of \$5.00 per hour, the value of volunteers working in the EFNEP program in 1989 amounted to \$2,996,940.

Supervision and management by State staff has provided support for more frequent visits, which has resulted in shorter enrollment periods. States report an increase in graduation rate and increased workloads per FTE paraprofessional.

Various methods were used to monitor improvement in diets, nutrition knowledge, food behavior practices, and (in a few cases) health indices of homemakers and youth. Methods included Survey I and II from the Eating Right Is Basic (ERIB-2) curriculum, computer dietary analysis, counting servings from four food groups, and birthweights of infants born to EFNEP mothers.

The 24-hour food recalls taken at entry and exit to the program measure behavior change in adult participants. In FY 1989, a 24-hour food recall disclosed that 46 percent of homemakers in a sample group had a diet with one or more servings of each of the four food groups when they entered the program. Moreover, only 4 percent of the homemakers in the sample group had a diet with two or more servings of milk and meat and four or more servings of vegetables/fruit and bread/cereals when they entered the program. Upon graduation, 90 percent of the homemakers in a sample group had a diet with one or more servings of each of the four food groups, and 36 percent of the sample were eating the recommended number of servings from each food group.

All States report an increase in cooperation with other agencies and private groups in order to implement the program in a more efficient manner. Most States have established referral systems with other Federal food assistance programs such as Women, Infants, and Children (WIC), and food stamps. Other public and private groups include Indian Reservations, Head Start, schools, Foster Care, Boys & Girls Clubs, Commodity Foods, State Departments of Education, Health Departments, YMCA, Salvation Army, and Teen Parent Programs. Many persons are recruited from these programs into EFNEP, and many persons are referred to these programs or are made aware of these programs by EFNEP. For example, in a cooperative effort between EFNEP, the Michigan Department of Agriculture, and WIC, Project FRESH provided coupons to low-income pregnant and lactating women and their children, to purchase fresh, Michigan-grown produce. Last year, approximately 10,000 women in 8 Michigan counties received \$15.00 worth of coupons to purchase fresh fruits and vegetables at farmers' markets. Ninety-one percent of the women redeemed their coupons--the highest redemption rate in the country. The Michigan Department of Agriculture feels that the education that EFNEP provided on how to access the market and purchase, prepare, and store the produce, increased Michigan's redemption rate.

#### b. Program Highlights

Many States specifically targeted pregnant teens and adult women at risk to help improve their prenatal and postpartum diets and, therefore, decrease low birthweight and improve healthy births and infant nutrition. The risk of low birthweight is higher for women who are poor, black, younger than age 17, who have little or no prenatal care, and who have inadequate diets and gain less than 20 pounds during pregnancy. Each year more than a quarter million infants are born low birthweight (under 5 pounds, 8 ounces). Low birthweight is most strongly associated with infant deaths that occur in the neonatal period or first month of life. Inadequate nutrition among pregnant women may account for as much as 57 to 65 percent of babies born with low birthweight. Alabama reported that the average birthweight for the 582 participants in their program was 7 pounds 5 ounces. Pennsylvania reports that 920 pregnant teens were instructed in a new curriculum entitled "Eating for a Better Start." Nevada reported that pregnant teens in their program gained an average of 32 pounds, which is near the recommended weight gain of 35 pounds, and the average birthweight was 6.93 pounds.

- o Indiana, Nevada, Ohio, California, Tennessee, and Wyoming each received \$2,000 grants from Kraft, Inc., to focus on developing and using electronic media in program delivery and marketing strategies for recruitment and program support in EFNEP. Indiana focused on training materials and videos on nutrition education for pregnant women in response to that State's high infant mortality rate. Nevada focused on interactive video instruction for EFNEP adults and pregnant teens. Ohio focused on interactive computer software to teach young people basic nutrition concepts. California focused on donor solicitation information tied to expanding EFNEP's outreach, especially in urban areas. Tennessee recruited public housing residents to work with other residents and their children in nutrition education programs. Wyoming focused on a self-study guide to complement nutrition curriculum videotapes.



- o Arkansas--2,196 homemakers decreased the dollars spent for food at an estimated savings of \$220 per family (\$484,477). Gardening and food preservation activities had an estimated economic impact of \$401,405 for 798 families or an average of \$503 per family. Behaviors adopted by 1,746 families on food recalls and food behavior scores resulted in an economic impact of \$2,137,986, or \$1,225 per family, to these families.
- o Mississippi--Because 20 percent of Mississippi's population is below the poverty line, EFNEP is a vital link to improving quality of life in this population. In FY 1989 5,411 new homemakers were enrolled in EFNEP. Of this number, 4,987 (92 percent) graduated. EFNEP in Mississippi achieved a more cost-effective method of operation by reducing dropout rate to 7 percent, by increasing enrollment, and by working in groups. Shorter enrollment time and the use of a standard curriculum also improved the total EFNEP process.
- o Guam--This small program had very large results. Seventy-five percent of the families enrolled in EFNEP graduated. Ninety-seven percent of the persons enrolled reported a more varied and improved diet. Eighty-eight percent of the persons enrolled reported improved food shopping, preparation, storage, safety, and sanitation skills.
- o Arizona--In South Tucson there was a 46 percent decrease in juvenile crime over the past 3 years due in some part to collaboration of area youth agencies, which included 4-H EFNEP. Among the adults in the program, upon entry a 24-hour food recall disclosed that only 56 percent were eating the minimum servings from all food groups. Upon graduation, 88 percent of the adults had a diet with one or more servings from each of the four food groups.
- o North Carolina--Working mothers were targeted in North Carolina. In one program, a group of working mothers completed an 8-week cable TV series. In another, a worksite wellness program met once a week for 15 weeks using the standard curriculum, ERIB-2. The plant manager's participation added to the commitment. As a result of these two programs, 98 working mothers improved diets, began a walking program, and reduced weight by an average of 13 pounds.

## 2. Other Ongoing Food and Nutrition Education Programs (ES)

Extension's nutrition, diet, and health programs provide participants with education related to food safety and recommended lifestyle patterns including dietary practices appropriate for clientele need according to age, sex, and state of life. The "USDA/DHHS Dietary Guidelines for Americans" and research findings serve as the bases for programs. Impact data from 1988 reports indicate that Extension programs emphasized increased knowledge of food safety issues, adoption of recommended food handling practices, and increased adoption of one or more of the Dietary Guidelines.



Some example programs:

o At-Risk Infants and Toddlers in Louisiana

The At-Risk Infant And Toddlers Program in Louisiana's St. John Parish had a significant impact on 400 families. In cooperation with five other parish (county) and State agencies, Cooperative Extension provided counseling on dietary habits and economical food buying to parents of children being screened for handicaps, deficiencies, and chronic illnesses. The Extension home economist was able to improve the eating habits of children in 85 percent of the families and helped 75 percent of the families use their food dollars more effectively. The total economic savings to the 400 families from the entire program was estimated to be \$155,600.

o Cholesterol 200 in Alabama

The Extension program, Cholesterol 200, in Alabama has been used throughout the State as an effective tool to help people separate fact from fiction surrounding the cholesterol issue. More than 1,500 consumers and professionals including food service workers, dietitians, and county health department nurses attended one of the programs. Programs were also given at many industries and a military base.

o Food Service Training in Tennessee

To improve safety in food service establishments, Tennessee Cooperative Extension provided training to 740 personnel in school systems, hospitals, nursing homes, and a restaurant. The training covered proper food handling, holding foods at proper temperature, and keeping foods covered.

o Working With Overweight Children in California

California's Cooperative Extension and Department of Health Services used a \$30,000 grant from the California Beef Council to educate health professionals on ways to effectively assist overweight children. The training reached 213 Extension and Health Services staff and 2,275 other health and education professionals. An evaluation of the program revealed that a majority of the professionals had developed a greater concern for the feelings of the overweight child and had significantly altered the advice they would provide to an overweight child.

o Education About Irradiated Food in New Hampshire

Consumer concerns about irradiated food were addressed by Cooperative Extension in New Hampshire through a total of 35 programs reaching 363 people. On a followup questionnaire, 98 percent of respondents indicated that they had gained more knowledge about food irradiation, and 82 percent said that they would buy or were undecided about buying irradiated food.

o Supermarket Programs in Wyoming and Connecticut

Wyoming and Connecticut Extension home economists effectively used supermarkets as a locale to provide education on the USDA/DHHS Dietary Guidelines for Americans and ways to change shopping habits to improve dietary

practices. A survey revealed that choosing low-fat instead of high-fat foods and choosing more whole grains and vegetables were major changes in practice made by the 578 people attending the programs.

o Improved Dietary Choices in Florida

In 21 Florida counties, Cooperative Extension used group presentations and workshops to educate 19,345 people on proper dietary choices. Evaluations of the programs indicated that 66 percent of the people adopted new dietary practices and 769 people averaged 7.2 lbs. in weight loss.

o Foodborne Illness in the District of Columbia

Extension home economists in the District of Columbia provided education on foodborne illness and safe food-handling practices to 1,727 consumers at 12 supermarkets.

o Diets for Seniors in Alabama

Older consumers received help with their diets from Alabama's Cooperative Extension through Senior Citizen Centers, churches, home visits, newsletters, and telephone calls. Of the 4,800 elderly who received information, 255 reported trying new foods and reducing the fat used in meal preparation.

o Food Service Worker Training in Oregon

Five counties in Oregon provided 166 food service workers with training on proper food handling and storage techniques. A survey revealed that as a result of the program, 31 percent of the participants had started washing their hands before handling food, and 54 percent were keeping perishable foods at their proper temperatures.

o Food for Tots in Oregon

Oregon Extension's "Food For Tots" newsletter series was instrumental in educating 2,900 families on healthful ways to feed preschoolers. Of those surveyed, 53 percent changed their attitudes about child feeding and 46 percent actually changed the eating practices of their family.

o National Risk Communication Training

The Extension Service conducted two regional Risk Communication/ Assessment training workshops in October and November 1990. Each State was invited to send a training team to the workshops. These training teams were then responsible for conducting in-State training. Other agencies and organizations were invited to send representatives to the workshops and to participate in the subsequent local training.

o Training Family Day-Care Providers

To address the critical need for expanded child care facilities, a cooperative agreement was signed with Massachusetts, Connecticut, and New Hampshire Cooperative Extension to integrate existing curricula and develop support materials to train Spanish-speaking, low-literacy, and low-income adults in

the skills necessary to become licensed/registered family day-care providers. The curriculum is undergoing pilot testing, and includes lessons on resource management, family life, nutrition, food safety, health, and the emotional and intellectual development of children. It is expected that the materials will be available nationally by the end of FY 1991.

o Safe Food-Handling Practices for Retail Food Operators

Cornell University was selected for funding by the Extension Service to develop a curriculum and training materials to teach safe food-handling practices to retail food operators, especially those in the supermarket industry. A videotape called "Food Quality, Food Safety, and You! An Education Program for Supermarket Deli Department Workers" is being prepared as part of this project.

o Home Food Preservation Guides Revised

A new publication called the "Complete Guide To Freezing Food at Home" is nearly completed. It was prepared in cooperation with Pennsylvania State University and supersedes the following USDA Home and Garden Bulletins: Number 10, "Home Freezing Fruits and Vegetables"; Number 40, "Freezing Combination Main Dishes"; and Number 93, "Freezing Meat and Fish in the Home." The publication deals with the recommended methods for preparing food for freezing to provide safe, nutritious, and high-quality frozen food.

Editorial changes for the Agriculture Information Bulletin 539, "Complete Guide to Home Canning" have been tabulated and are available for the next printing. The publication is currently out of print. Some of the changes include a reduction of salt in directions and procedure modifications to give a better product. The "Let's Preserve" series, which includes directions for canning 15 foods, has been revised to be in complete agreement with the "Complete Guide to Home Canning." The "Complete Guide to Home Canning" and the "Let's Preserve" series were updated in cooperation with Pennsylvania State University.

o Home Food Preparation Survey

Cornell University is conducting a survey on home food preparation practices and food safety perceptions in New York and, based on the results, will expand it into a national survey. Objectives are to obtain timely information on consumer home food preparation practices and perceptions, to determine consumer attitudes concerning level of interest, to identify groups who require food safety information, to determine the best method of providing information, and to determine the current level of consumer usage and confidence in home food safety information.

3. National Agricultural Library Programs

The Food and Nutrition Information Center (FNIC) continues to serve as a source of nutrition information and educational resources for consumers, educators, researchers, health professionals, and food service managers. The Center provides comprehensive reference/research support to the U.S. Congress, Federal Government agencies, and libraries and information centers. Through an interagency agreement with the Food and Nutrition Service, USDA,



cooperators with the FNS programs are eligible for unrestricted services from FNIC. Other users may obtain FNIC materials through interlibrary loan; comprehensive reference assistance is available on a cost recovery basis.

- o New Bibliographies/Information Products

NAL Quick Bibliographies and Special Reference Briefs have been published on the following topics: childhood obesity and cardiovascular disease, nutrition and the elderly, and pesticide residues in food. Updates to nutrition education materials, grades preschool through 6, and nutrition education materials, grades 7 through 12, were also produced.

New Pathfinders (a reviewed, brief reading list of print and audiovisual materials) have been developed on the following subjects: children's literature on food and nutrition; diet and cancer; nutrition and diabetes; nutrition and the handicapped; nutrition, learning, and behavior; and sports nutrition.

FNIC received additional funding from the Food and Nutrition Service, USDA, in FY '90 to continue with the updating of the publication, Nutrition Education Resource Guide: An Annotated Bibliography of Educational Materials for the WIC and CSF Programs. Special features of this publication include evaluative appraisals and reading level analyses of each publication. A 1991 publication date is planned.

- o FNIC Microcomputer Software Demonstration Collection

The software demonstration collection continues to expand. Currently, there are over 170 computer programs for dietary analysis, nutrition education, and food service management. Software is available for onsite preview by appointment.

#### 4. Commodity Education Programs

- o AMS Continues To Grade More USDA Select Beef

Since the beef grade USDA Good was renamed USDA Select, there has been an increase in the amount of this beef graded by AMS. When the name change became effective in November 1987, USDA Good represented less than 2 percent of the total graded steer and heifer beef supply. By June 1990, USDA Select represented over 16 percent. AMS continues to respond to industry and press inquiries about the name change. The Select name has provided a more positive image for leaner beef, giving the industry an increased marketing opportunity to provide the leaner, less marbled beef that many consumers want today.

#### 5. Graduate Fellowships Grants Program Activities--1990

The U.S. Department of Agriculture Food and Agricultural Sciences National Needs Graduate Fellowships Grants Program was initiated in 1984 to attract academically outstanding scholars into advanced studies in the food and agricultural sciences. The program provides 3 years of training for a doctoral student and 2 years for a masters student in one of the following national needs shortage areas: food science/human nutrition; biotechnology;

food, forest products, and agribusiness management and marketing; agricultural engineering; and water sciences.

The Fellowships Program has achieved a notable record and is proving to be an important part of the solution to the serious erosion of our scientific expertise. More than 400 fellows have participated in the program to date in prestigious graduate departments at both land-grant and non-land-grant universities. Twenty-five percent of the fellows have received support in the national needs area of Food Science/Human Nutrition.

In FY 1990, almost \$2.8 million was available to fund the program. There were 29 proposals submitted in Food Science/Human Nutrition, and FY 1990 Fellowships Grants were awarded in the amount of \$96,000 to each of the following institutions: University of California-Davis, University of Georgia, University of Illinois, University of Minnesota, Pennsylvania State University, and University of Wisconsin. By December 1991, project directors at these institutions will select 12 doctoral fellows for 3 years of support.

#### 6. Food and Nutrition Service Programs

##### o USDA/DHHS Kansas-Wyoming Pilot Nutrition Education Project for the Food Distribution Program on Indian Reservations

The FNS Mountain Plains Region is currently collaborating with the Indian Health Service, FNS program directors, and Indian tribal representatives to conduct a "train the trainer" workshop/seminar in two States, Kansas and Wyoming. An audience of cooks and health officials from schools, day-care centers, and community health centers serving Indians will be taught how to plan the use of, store, and cook commodity foods to maximize nutritional benefits.

Regional Office staff are also working with Expanded Food and Nutrition Education Program staff in Wyoming to explore the feasibility of training nutrition aides to deliver educational services to households on an Indian Reservation.

##### o National Food Service Management Institute

P.L. 101-147 authorized the establishment of the Institute through Fiscal Year 1994 at the University of Mississippi to improve the quality of Child Nutrition Programs through training, technical assistance, research, and management support for child nutrition food service programs. FY 1990 funding level provided \$500,000. Among FY 1990 activities was the creation of a seven-member General Advisory Board, whose primary function is the development of a comprehensive, long-range plan for the Institute.

##### o Dangers of Drug Abuse During Pregnancy

During certification and nutrition education sessions, WIC local agency professionals will inform WIC participants about the dangers of the use of tobacco, alcohol, and other drugs during pregnancy and lactation. Materials being developed for this purpose include a videotape, pamphlet, and poster for



use with WIC participants and a resource manual and videotape to train WIC local agency professionals on screening participants and making referrals for further assessment.

- o Emphasis on Breastfeeding

FNS is continuing its ongoing efforts to promote breastfeeding in the WIC and CSF programs through developing publications; coordinating with other Federal agencies and private organizations; and funding breastfeeding education grants, demonstration projects, and conferences to train WIC local agency professionals on how to effectively promote and support breastfeeding. The U.S. Department of Agriculture, with endorsement from other Federal agencies, anticipates taking the lead in developing a nationwide multimedia campaign to promote breastfeeding. In addition, based on legislative mandates of Public Law 101-147, a proposed WIC rule published July 9, 1990, establishes a national definition for the term "breastfeeding" and sets standards for the promotion and support of breastfeeding for WIC State and local agencies.

- o WIC's Role in Encouraging Immunizations

The Centers for Disease Control, Division of Immunization, DHHS, and FNS have initiated a cooperative effort to increase immunization rates among preschool-age WIC participants who are 12 months through 2 years of age. On June 7, 1990, a joint letter signed by Assistant Secretary Catherine Bertini, Food and Consumer Services, USDA, and James O. Mason, Assistant Secretary for Health, DHHS, encouraging increased cooperation in this area was sent to all State health commissioners. FNS will emphasize coordinated efforts between State WIC directors and State immunization program managers and other health and human service programs as a WIC Program priority. FNS will send a letter to State WIC directors asking that they aggressively promote, at a minimum, measles immunizations for WIC participants who are 12 months through 2 years of age. CDC will send a similar letter to the State immunization program managers encouraging them to coordinate with the WIC program. FNS and CDC will explore the possibility of a demonstration project to provide immunization services at a WIC agency which does not currently offer onsite immunization.

- o "Infant Formula, Exempt Infant Formulas, and Medical Foods Available in the WIC Program"

A reference has been published to assist State and local WIC cooperators and FNS personnel by providing general information on 121 formulas used in the WIC Program. The information includes special features and composition, purpose and function, intended user, and general cautions to be considered in the use of the products. The appendixes, consisting of tables for 10 classes of products, contain information on each product's caloric density and distribution; protein, carbohydrate, and fat source(s); osmolality; iron content; and packaging information. The reference also contains a list of resources from each formula company and an index listing the products alphabetically and primarily by features.



- o "Nutrition and Feeding During Infancy: A Handbook for Use in the WIC Program"

This handbook is being developed by FNS for use as a reference guide for nutritionists and other health professionals who provide nutrition education to caretakers of infants on the WIC Program. The publication presents information on the nutritional needs of infants, breastfeeding and formula feeding, infant feeding practices, infant development, safe food preparation and storage, and WIC food packages for infants.

- o "WIC Exchange: Ideas To Help Nutrition Educators Help Clients"

This publication provides information to WIC nutrition educators on how to plan, implement, and evaluate nutrition education. It includes practical guidance as well as positive examples of education services from actual WIC clinics.

- o "Quick and Easy Cooking for the Food Distribution Program on Indian Reservations"

This is a recipe book developed by the Food and Nutrition Service (USDA) in conjunction with the Indian Health Service (DHHS) to specifically help participants on the Food Distribution Program on Indian Reservations make better use of the commodity foods they receive in their monthly food package. Besides the 70 recipes, there are commodity food substitutions for commercial foods and cooking ingredients plus weight-volume equivalency charts for participants. The recipe book also gives information to program cooperators on planning, cooking, and eating for better health to incorporate into their local nutrition education lessons.

- o Modification and Enhancement of the Computerized Food Package Modeling Systems (CFPMS)

CFPMS is a software program designed to allow users to evaluate the impact of changes on the nutritional content and cost of food packages for three of FNS' food assistance programs, including the WIC program. It can also be used as a tool to help answer research questions regarding the formulation of new or tailored food packages. All programming tasks to update and refine the CFPMS software have been completed as well as the User Manual and outline for the Program Maintenance Manual. Award of a contract to complete development of the maintenance manual has been postponed until the Agency allocates funds to purchase services to write it. This project is ongoing since new nutrient data is constantly being added to the computerized food package modeling system.

- o Make Your Food Dollars Count Workshops

These train-the-trainer workshops were held at locations in two FNS regions. The workshops continue in the Make Your Food Dollars Count tradition of giving information and materials to educators for Food Stamp Program participants on making wise food shopping choices and some basic nutrition information on how to provide an economical and nutritious diet.

#### IV. FUNDING LEVELS (1986-91)

The expenditures for human nutrition research and human nutrition education and information by the several agencies in USDA for FY's 1986 through 1991 are summarized in table 2. The congressional appropriation for FY 1991 is also included. The total amount of human nutrition research support has increased from \$60.8 million in FY 1986 to \$74.9 million in FY 1991, an increase of 23 percent. During the same period, support for human nutrition education and information has increased from \$133.2 to \$180.6 million, an increase of 35.6 percent. The total support for human nutrition in the congressional appropriation for FY 1991 is \$255.5 million or 31.7 percent more than was expended in FY 1986.

Table 3 shows the amount of human nutrition research support within the Department for this period by subject area categories and agency. Over half of the human nutrition research effort is focused on determining nutrient requirements/health maintenance at all stages of life. About one-sixth of the effort relates to the development of methods for measurement of nutritional status and collection of food consumption information. Approximately one-sixth of the funds is used to measure the content and bioavailability of nutrients in foods. The funds shown in the table do not include funds provided by the States or other sources and used in conjunction with those funds provided by the Cooperative State Research Service (CSRS).

Funds available for competitive research grants in human nutrition through CSRS were increased in the appropriation from \$1.0 million in FY 1989 to \$1.5 million in FY 1990.

Table 4 presents a breakdown of human nutrition education and information expenditures and budgets by subject category for the FY's 1986 through 1991.

A summary of actual expenditures and estimated support and the congressional appropriation is given in table 5 for the five Human Nutrition Research Centers and other laboratories or centers of the Agricultural Research Service (ARS) for FY's 1986 through 1991. The net figure refers to funds to the location, while the gross amount includes overhead costs.

The Center at Tufts University in Boston is operated by ARS as a Government-owned, contract-operated (GOCO) facility. The Center at Baylor College of Medicine in Houston is operated by ARS through a cooperative agreement.

Human nutrition research support at ARS Regional Research Centers and other laboratories is shown in table 6. These studies help to ensure that problems and opportunities in human nutrition are considered in research directly related to the quality of the food supply.

Funds available in the WIC Program for drug abuse education and referrals for counseling and treatment were \$5.5 million for each of FY's 1989 and 1990.

Table 2

U.S. DEPARTMENT OF AGRICULTURE  
HUMAN NUTRITION RESEARCH, EDUCATION, AND INFORMATION  
SUPPORT (FY 86-91)

HUMAN NUTRITION RESEARCH  
(\$ in Millions)

	<u>FY</u> <u>1986</u> actual	<u>FY</u> <u>1987</u> actual	<u>FY</u> <u>1988</u> actual	<u>FY</u> <u>1989</u> actual	<u>FY</u> <u>1990</u> actual	<u>FY</u> <u>1991</u> estimate
ARS	37.8	40.6	44.3	45.7	47.9	49.6
CSRS	7.5	7.5	7.6	6.9	8.2	11.1
HNIS	12.8	6.1	7.1	7.7	7.9	8.1
ERS	1.1	1.2	1.0	.9	.9	1.1
FNS	<u>1.5</u>	<u>.5</u>	<u>.5</u>	<u>.6</u>	<u>2.8</u>	<u>5.0</u>
TOTAL	60.8	55.9	60.5	61.8	67.7	74.9

Human Nutrition Education and Information

ES	73.5	73.5	75.0	75.0	74.6	77.3
HNIS	1.2	.7	1.2	1.1	1.1	1.3
FNS	57.6	60.4	65.5	71.6	86.6	101.2
FSIS	.4	.13	.1	.2	.1	.1
NAL	<u>.5</u>	<u>.4</u>	<u>.5</u>	<u>.7</u>	<u>.7</u>	<u>.7</u>
TOTAL	133.2	135.1	142.3	148.6	163.1	180.6

TOTAL RESEARCH,  
EDUCATION, AND  
INFORMATION

194.0	191.0	202.8	210.4	230.8	255.5
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Table 3

USDA NUTRITION RESEARCH PROGRAM SUPPORT (FY 86-91)  
(\$ in Millions)

	<u>FY 1986 actual</u>	<u>FY 1987 actual</u>	<u>FY 1988 actual</u>	<u>FY 1989 actual</u>	<u>FY 1990 actual</u>	<u>FY 1991 estimate</u>
1. Nutrient Requirements/ Health Maintenance						
CSRS	3.9	4.6	4.2	4.0	4.2	6.3
ARS	<u>27.5</u>	<u>29.9</u>	<u>31.0</u>	<u>33.3</u>	<u>37.7</u>	<u>38.1</u>
Total	<u>31.4</u>	<u>34.5</u>	<u>35.2</u>	<u>37.3</u>	<u>41.9</u>	<u>44.4</u>
2. Nutritional Status/ Food Intake						
CSRS	1.7	1.3	1.8	1.3	2.4	2.9
ARS	3.1	3.9	3.9	4.0	2.5	3.3
HNIS	9.9	3.2	3.9	4.8	4.9	5.1
FNS	---	---	---	.1	---	0.6
Total	<u>14.7</u>	<u>8.4</u>	<u>9.6</u>	<u>10.2</u>	<u>9.8</u>	<u>11.9</u>
3. Use of Food/Food Choices						
CSRS	0.2	0.2	0.2	0.3	0.3	0.2
HNIS	1.1	1.1	1.3	1.1	1.1	1.1
ERS	.8	.9	.7	.8	.8	1.0
FNS	---	---	---	---	.1	---
Total	<u>2.1</u>	<u>2.2</u>	<u>2.2</u>	<u>2.2</u>	<u>2.3</u>	<u>2.3</u>
4. Nutrient Composition/ Bioavailability						
CSRS	1.6	1.3	1.4	1.2	1.2	1.6
ARS	7.2	6.8	9.4	8.4	7.7	8.2
HNIS	<u>1.8</u>	<u>1.8</u>	<u>1.9</u>	<u>1.8</u>	<u>1.9</u>	<u>1.9</u>
Total	<u>10.6</u>	<u>9.9</u>	<u>12.7</u>	<u>11.4</u>	<u>10.8</u>	<u>11.7</u>
5. Nutritional Impacts of Programs						
CSRS	0.1	0.1	0.1	0.1	0.1	0.1
ERS	.3	.3	.1	.1	.1	.1
FNS	<u>1.5</u>	<u>.5</u>	<u>.5</u>	<u>.5</u>	<u>2.7</u>	<u>4.4</u>
Total	<u>1.9</u>	<u>0.9</u>	<u>0.7</u>	<u>0.7</u>	<u>2.9</u>	<u>4.6</u>
TOTALS						
CSRS	7.5	7.5	7.7	6.9	8.2	11.1
ARS	37.8	40.6	44.3	45.7	47.9	49.6
HNIS	12.8	6.1	7.1	7.7	7.9	8.1
ERS	1.1	1.2	.8	.9	.9	1.1
FNS	<u>1.5</u>	<u>.5</u>	<u>.5</u>	<u>.6</u>	<u>2.8</u>	<u>5.0</u>
USDA Total Nutrition Research	<u>60.8</u>	<u>55.9</u>	<u>60.4</u>	<u>61.8</u>	<u>67.7</u>	<u>74.9</u>

Table 4

USDA FOOD AND NUTRITION EDUCATION AND INFORMATION SUPPORT (FY 86-91)  
(\$ in Millions)

	FY <u>1986</u> actual	FY <u>1987</u> actual	FY <u>1988</u> actual	FY <u>1989</u> actual	FY <u>1990</u> actual	FY <u>1991</u> estimate
Extension Service <sup>1/</sup>						
Extension (Formula estimate)	15.9	15.9	16.4	16.4	16.4	16.8
Expanded Food and Nutrition Education Program (EFNEP)	57.6	57.6	58.6	58.6	58.2	60.5
Total	<u>73.5</u>	<u>73.5</u>	<u>75.0</u>	<u>75.0</u>	<u>74.6</u>	<u>77.3</u>
National Agricultural Library						
Food, Nutrition and Human Ecology Staff	0.5	0.4	0.5	0.7	0.7	0.7
Human Nutrition Information Service						
Guidance and Education Research Branch	1.2	0.7	1.2	1.1	1.1	1.3
Food and Nutrition Service <sup>1/</sup>						
Nutrition Education & Training Program (NET)	5.0	5.0	5.0	5.0	5.0	7.5
Special Supplemental Food Program for Women, Infants and Children (WIC) <sup>2/</sup>	52.6	55.4	60.5	66.6	86.3	93.7
Total	<u>57.6</u>	<u>60.4</u>	<u>65.5</u>	<u>71.6</u>	<u>91.3</u>	<u>101.2</u>
Food Safety and Inspection Service						
Nutrition Labeling	0.1	0.1	0.1	0.1	0.1	0.1
Nutrition and Sodium Information*	0.1	0.02	---	---	---	---
Sodium Monitoring Program*	0.2	0.01	---	---	---	---
FDA/FSIS Labeling Consistency*	---	---	---	.1	---	---
Total	<u>0.4</u>	<u>0.13</u>	<u>0.1</u>	<u>0.2</u>	<u>0.1</u>	<u>0.1</u>
USDA Total Nutrition Education and Information	133.2	135.1	142.3	148.6	163.1	180.6

<sup>1/</sup> Most funds are distributed to and managed by State agencies.

<sup>2/</sup> Estimate of State administrative funds allocated for nutrition education.

\*Programs discontinued.

Table 5

AGRICULTURAL RESEARCH SERVICE  
HUMAN NUTRITION RESEARCH SUPPORT (FY 1986-91)

Estimated Funds (\$ in Millions)

		<u>FY</u> <u>1986</u> <u>actual</u>	<u>FY</u> <u>1987</u> <u>actual</u>	<u>FY</u> <u>1988</u> <u>actual</u>	<u>FY</u> <u>1989</u> <u>actual</u>	<u>FY</u> <u>1990</u> <u>actual</u>	<u>FY</u> <u>1991</u> <u>estimate</u>
BHNRC, Beltsville, MD	Gross	7.91	8.34	8.42	8.12	8.27	8.66
	Net	7.02	7.41	7.35	7.31	7.48	7.82
GFHNRC, Grand Forks, ND	Gross	6.36	6.66	7.11	7.03	7.29	7.67
	Net	5.64	5.92	6.32	6.33	6.59	6.93
HNRCA, Boston, MA	Gross	11.75	12.76	13.68	14.06	14.26	14.56
	Net	11.16	12.12	12.99	13.35	13.54	13.83
CNRC, Houston, TX	Gross	4.43	5.43	7.65	9.07	10.43	10.72
	Net	3.93	4.88	6.99	8.34	9.63	9.91
WHNRC, San Francisco, CA	Gross	3.66	4.23	4.49	4.46	4.67	5.00
	Net	3.25	3.76	3.95	4.01	4.22	4.52
TOTAL, HN Centers	Gross	34.12	37.43	41.35	42.74	44.92	46.60
	Net	31.01	34.09	37.59	39.34	41.47	43.01
Other ARS HN Research	Gross	3.65	3.18	3.01	2.96	2.96	2.99
	Net	3.24	2.86	2.65	2.66	2.67	2.72
TOTAL, Human Nutrition	Gross	37.76	40.61	44.36	45.70	47.87	49.59
	Net	34.24	36.95	40.25	42.00	44.14	45.73



Table 6

AGRICULTURAL RESEARCH SERVICE

OTHER ARS HUMAN NUTRITION RESEARCH SUPPORT (FY 86-91)\*  
(\$ in Thousands)

		<u>FY</u> <u>1986</u> <u>actual</u>	<u>FY</u> <u>1987</u> <u>actual</u>	<u>FY</u> <u>1988</u> <u>actual</u>	<u>FY</u> <u>1989</u> <u>actual</u>	<u>FY</u> <u>1990</u> <u>actual</u>	<u>FY</u> <u>1991</u> <u>estimate</u>
Beltsville, MD	Gross	--	--	128.7	121.8	116.8	117.3
	Net	--	--	111.8	109.6	105.6	106.7
Ithaca, NY	Gross	601.3	750.9	765.0	755.4	743.0	736.0
	Net	533.5	675.9	676.0	679.7	671.8	669.5
Wyndmoor, PA	Gross	667.1	303.1	--	--	--	--
	Net	591.8	272.9	--	--	--	--
Peoria, IL	Gross	985.5	982.4	1,017.5	1,007.1	1,068.1	1,072.7
	Net	874.5	884.3	898.8	906.3	965.8	975.8
Albany, CA	Gross	959.2	712.7	653.8	493.0	483.9	487.2
	Net	851.0	641.5	576.3	443.6	437.6	443.2
Hyattsville, MD	Gross	433.5	432.7	443.1	580.0	545.3	579.0
	Net	<u>384.6</u>	<u>389.5</u>	<u>391.0</u>	<u>521.9</u>	<u>493.1</u>	<u>523.5</u>
	Gross	3,646.6	3,181.8	3,008.1	2,957.3	2,957.1	2,992.2
	Net	3,235.6	2,864.1	2,653.9	2,661.1	2,673.9	2,718.7

\*Excludes Human Nutrition Centers.

Each year WIC State agencies must spend a minimum total for all States of \$8 million nationwide for breastfeeding promotion activities. These expenditures must be made from States' WIC administrative grants (or other sources) and do not constitute additional Federal appropriations.

WIC participation continued to increase in FY 1990 from an average of 4.1 million participants each month to 4.5 million. WIC nutrition education services were provided to an additional 400,000 participants.

## V. COORDINATION AND ADVISORY MECHANISMS

### A. Coordination Within the Federal Sector

#### 1. Interagency Committee on Human Nutrition Research (ICHNR)

The ICHNR continued to coordinate human nutrition research activities at the Federal level under the leadership of cochairpersons, Dr. Charles Hess, Assistant Secretary for Science and Education, USDA, and Dr. James Mason, Assistant Secretary for Health, DHHS. Meetings were held at quarterly intervals with representatives from member Departments and agencies as follows: Agency for International Development, USDA, National Aeronautics and Space Administration, Department of Commerce, Department of Defense, DHHS, National Science Foundation, Department of Veterans Affairs, and Office of Science and Technology Policy. Scientific topics discussed at these meetings included (1) nutrition and AIDS, (2) Lp(a): a new independent risk factor for coronary artery disease, and (3) tryptophan-associated eosinophilia-majalgia syndrome.

During the year, the Subcommittee on the Human Nutrition Research Information Management System (HNRIMS) met and developed recommendations for improvements in coding of ongoing federally funded human nutrition research included in this computerized system.

Plans were also made to hold the Fifth Conference for Federally Supported Human Nutrition Research Units and Centers, held February 20-21, 1991, in Bethesda, Maryland. The topics covered were: (1) Studies on Dietary Risk Factors; (2) Energy Balance, Body Composition, and Obesity; and (3) Minerals and Trace Elements--Requirements and Safe Levels for Humans.

#### 2. Interagency Committee on Nutrition Monitoring

This Committee was established in 1988 in recognition of the need for strong, sustained, and coordinated Federal efforts to monitor the nutritional status of the American people. Its purpose is to enhance the effectiveness and productivity of nutrition monitoring efforts by improving the planning, coordination, and communication among agencies engaged in nutrition monitoring. Co-chairs are the USDA Assistant Secretary for Food and Consumer Services and the DHHS Assistant Secretary for Health. Agencies represented include USDA's ARS, FNS, HNIS, and ERS; DHHS' NIH, FDA, NCHS, and CDC; Veterans Administration; Department of Defense; Agency for International Development; Census Bureau; and Bureau of Labor Statistics. Working groups under the auspices of the Committee are addressing priority issues in the areas of survey complementarity, Federal-State information dissemination and exchange, and food composition data.

#### 3. USDA/DHHS Cooperation in Nutrition Monitoring

The HNIS/USDA and the National Center for Health Statistics (NCHS), DHHS, are continuing their joint coordination and collaboration in conducting the USDA Continuing Survey of Food Intakes by Individuals and the NCHS third National Health and Nutrition Examination Survey, the core surveys of the National



Nutrition Monitoring System. A joint HNIS/NCHS Nutrient Data Base Committee meets regularly to ensure continued development of compatible nutrient data systems for handling and coding nutrient data for dietary intake surveys. This collaboration, as well as the joint publication of the Dietary Guidelines for Americans, is coordinated by the Assistant Secretaries for Health in DHHS and for Food and Consumer Services in USDA.

#### 4. Joint USDA/DHHS Evaluation of Core Monitoring Surveys

The HNIS/USDA and DHHS are jointly sponsoring an evaluation of sampling and variable definition methodology of the NFCS and NHANES III. This evaluation, conducted under contract with Research Triangle Institute, will recommend options for increasing comparability and complementarity in sampling and variable definitions for these two major surveys of the NNMS and provide useful input for incorporation into the planning and design of upcoming surveys.

#### 5. Plans for Third Report to Congress of the National Nutrition Monitoring System

Two comprehensive reports that integrate results of the monitoring system components have been sent to Congress by USDA and DHHS--the first in 1986 and the second in 1989. Plans are being made for the third report on the dietary and nutritional status of the U.S. population which is to be sent to Congress in 1992. As a first step in planning this report, information has been collected from individuals and groups representing nutrition and health professionals, and policymakers who were users of the first two reports. Information collected through meetings and teleconferences has included uses and usefulness of the data and special topic areas in the reports, and ideas related to the focus and presentation of the third report. Plans are to also solicit information from Congress and assess recommendations received in developing the focus and presentation of future reports.

#### 6. Omnibus Budget Reconciliation Act of 1989 (P.L. 101-239)

By December 19, 1990, DHHS in consultation with USDA had to develop and disseminate a model application form in order to provide simultaneous application for pregnant women and children under 6 for the following programs without changing any program eligibility requirements: Maternal and Child Health Block Grant, Medicaid, Migrant and Community Health Centers Programs, Grants for the Homeless, Head Start, and WIC.

Effective July 1, 1990, Medicaid State Plans had to provide for coordination with WIC and must notify pregnant, breastfeeding, and postpartum women and children under 6 of the availability of WIC and refer them to the State agency. Implementation guidance for both of these has been issued to Medicaid State agencies.

#### 7. Nutrition Labeling Study (FSIS)

The Department of Agriculture's Food Safety and Inspection Service (FSIS) and the Department of Health and Human Services sponsored a nutrition labeling study, conducted by the National Academy of Sciences (NAS), to consider how food labels could be improved to help consumers adopt or adhere to healthy diets.

The report published from the NAS study, Nutrition Labeling Issues and Directions for the 1990's, assessed the implications of the current knowledge of nutrition and health for food labeling, recommended the content and formats for food labels, and examined current laws and regulations governing ingredient and nutrition labeling. FSIS is utilizing the findings of the NAS report in moving forward with a regulatory proposal to mandate nutrition labeling.

#### 8. Other Activities

##### o USDA/DHHS Joint Publication for Child Nutrition Programs

P.L. 101-147 mandated that the Departments of Agriculture and Health and Human Services jointly develop, coordinate, and distribute a publication entitled "Nutrition Guidance for Child Nutrition Programs." Initial meetings between the Departments have taken place as well as preliminary planning for forming a working group.

##### o FNS/DHHS, Maternal and Child Health (MCH) Joint Effort on Lactation Management

FNS, under an Interagency Agreement with MCH, sponsored three training conferences coordinated by MCH to improve breastfeeding promotion in State/local WIC/MCH programs. WIC awarded funding for three additional lactation conferences to be implemented in FY 1991. The Supplemental Foods Program (WIC) plans to continue funding such conferences, if there is continued interest.

##### o Interagency Agreement for Drug Abuse Coordination

An interagency agreement dated May 1989 between FNS and the Office for Substance Abuse Prevention (OSAP), Alcohol, Drug Abuse, and Mental Health Administration, DHHS, established a formal mechanism for coordinating WIC's activities related to drug abuse information and referrals. The objective is to improve the provision of services to pregnant and postpartum women and infants, particularly through drug abuse information and referrals. Under this agreement, OSAP provided technical assistance to WIC for the legislated study of the appropriate methods for drug abuse information and referrals in the WIC Program and for development of materials as a result of the study.

##### o Interaction With Health Care Financing Administration (Medicaid) and Family Support Administration (AFDC)

FNS meets periodically with a group representing these programs to discuss issues of mutual concern and to exchange information. Lately FNS has been working closely with these programs to secure the level of understanding of their operations that is necessary to implement WIC adjunct income eligibility. FNS expects to be working with HCFA on implementation of the OBRA '89 program coordination mandates.

##### o USDA and DHHS Cooperate With the Expert Consultants' Meeting

A representative of the Food and Nutrition Service participated in the Expert Consultants' Meeting, December, 1989, sponsored by DHHS' Public Health



Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Divisions of Adolescent and School Health and Nutrition. This meeting focused on developing guidelines for effective school-based nutrition education programs, including school food service programs that complement and reinforce educational content. The process for development of a coordinated plan will involve Federal and private sector representatives in a series of working conferences. The Food and Nutrition Service is working with the Division of Nutrition (DN) for cooperative use of the results of a nutrition education survey conducted under contract by DN in assessing the needs for nutrition education of children as mandated by Congress in conjunction with the Nutrition Education and Training Program for FY 1990.

- o USDA Coordinates With DHHS, Public Health Service, Office of Disease Prevention and Health Promotion

The Food and Nutrition Service meets with representatives of the Office of Disease Prevention and Health Promotion (ODPHP) on a periodic basis to exchange information and plans for their respective school lunch initiatives to promote creative ways to implement the U.S. Dietary Guidelines in school meals. Currently, ODPHP has a 17-month cooperative agreement with the American School Food Service Association for a project to identify and disseminate information about exemplary school food service programs, and FNS has a series of school food authority menu modification grants to learn more about the process and effects of making changes to school meals in accordance with the Dietary Guidelines.

- o USDA and DHHS Cooperation on Head Start and Child and Adult Care Food Program

The Head Start Bureau's Office of Human Development, Administration for Children, Youth, and Families and the Public Health Service's Health Resources and Services Administration, Maternal and Child Health Bureau are cooperating agencies with FNS on the child care component of the Child and Adult Care Food Program. Periodic meetings are held to discuss current needs in the nutrition component of the Head Start Program as well as to plan and implement cooperative work.

- o USDA/DHHS Nutrition Education Committee for Maternal and Child Nutrition Publications

In response to a need for a mechanism for a joint effort on nutrition education materials related to pregnancy and infant care, the Assistant Secretary for Health, DHHS, and the Assistant Secretary for Food and Consumer Services, USDA, established the USDA/DHHS Nutrition Education Committee for Maternal and Child Nutrition Publications in November 1980. The committee, which meets three times a year, serves as a systematic mechanism for agencies within USDA and DHHS to report their plans and progress related to maternal and child nutrition education in an effort to avoid duplication and make more effective use of resources. An FNS staff member serves as Department coordinator for this joint effort.



- o Inter-Program Coordination Through Income Eligibility Determinations

P.L. 101-147 increases coordination of the WIC Program with the Food Stamp, AFDC, and Medicaid Programs through the income eligibility determinations processes. In addition, WIC Program staff is required to provide informational materials on these social service programs to WIC applicants.

- o DHHS National Health Objectives for the Year 2000

HNIS is representing USDA on the Nutrition Objectives Working Group of the DHHS National Health Objectives for the Year 2000 in order to promote uniformity between the Departments. National Health Objectives for the Year 2000 were issued by DHHS at the Healthy People 2000 Conference. As a member of the working group, HNIS was involved in developing the Nutrition Objectives and ensuring that the concepts of the Dietary Guidelines for Americans were considered as the basis for dietary guidance.

- o National Cholesterol Education Program

HNIS provides USDA's liaison representative to the National Cholesterol Education Program (NCEP) Coordinating Committee. In this role, the Committee is kept informed of USDA research results from food consumption surveys regarding dietary status and activities that are supportive of the Dietary Guidelines for Americans.

- o DHHS/Extension Service Cooperation

The Extension Service has been working closely with the National Heart, Lung, and Blood Institute, National Cancer Institute, and National Cholesterol Education Program to facilitate the distribution of information and educational materials throughout the Extension delivery network. Discussions with the National Cancer Institute and the Center for Disease Control indicate an interest in cooperative projects.

- o MOU Between ES and FDA

Extension Service and the Food and Drug Administration have a Memorandum of Understanding to establish the basis of increased cooperative programming. Staff from both agencies have been meeting to discuss potential areas of cooperation.

## B. Coordination Within USDA

### 1. Subcommittee for Human Nutrition

The Subcommittee for Human Nutrition of the Department's Research and Education Committee meets at monthly intervals. It serves as the primary mechanism for coordination of human nutrition activities in USDA. It has met regularly with monthly meetings of representatives from those USDA agencies involved and liaison members from DHHS, NIH, and industry groups. The Subcommittee provides the mechanism for regular information exchange and discussion and planning on human nutrition policy issues. The Subcommittee also serves as the vehicle for the implementation of cooperative program activities. For example, the Subcommittee prepared a comprehensive 5-year plan for human nutrition research and education in USDA. It developed a USDA food and nutrition policy statement and prepared annual progress reports for Congress.

### 2. Dietary Guidance Working Group

The Dietary Guidance Working Group, formed under the Subcommittee for Human Nutrition in 1986, continues to review all publications, including prospectuses and publication drafts, presenting dietary guidance information. The review process is thorough and timely for ensuring that guidance conforms to the Dietary Guidelines and is consistent and supportive across USDA agencies and the Federal Government. The group, composed of representatives from 10 USDA agencies and a DHHS liaison, also serves as a means of communication among nutrition education specialists in the USDA agencies that provide guidance to their clientele.

### 3. FNS and HNIS Cooperation on Federal Food Assistance Program Standards and Guidance

FNS and HNIS cooperate in the development of certain food assistance program standards, such as the thrifty food plan for establishing benefits in the Food Stamp Program and meal patterns for measuring compliance in the National School Lunch Program. HNIS-generated data bases on food composition and food consumption and prices are used in developing the standards.

### 4. HNIS and ERS Cooperation on Food Supply Data

ERS and HNIS cooperate in estimating and publishing information on trends in the nutrient content of U.S. food supplies.

### 5. HNIS and ES Cooperation on Nutrition Education Information Needs

Through a Memorandum of Understanding, ES and HNIS work together in achieving their common goals in nutrition education. A Cooperative Extension System/Extension Service/HNIS Consulting Group meets periodically through teleconferences and once a year through a face-to-face meeting to facilitate communications and advise HNIS staff concerning future nutrition education needs. This year's teleconferences and meeting focused on the "Eating Right..." Campaign, the Federal Dietary Guidelines Advisory Committee

progress, an HNIS recipe workshop, the new food guide publication and HNIS research targeted for special audiences.

#### 6. Food Safety Data Initiative

A comprehensive program to collect and analyze data regarding pesticide use, residue levels, and potential exposure levels from selected commodities in the Nation's food supply was proposed in the President's FY 1991 budget. The \$25 million initiative, to be administered by several USDA agencies, would substantially upgrade the availability and statistical reliability of information on pesticide use and levels of pesticide residues in the food supply.

On-farm pesticide use data would be collected by NASS. States entering into agreements with AMS would do the sampling of commodities and testing for levels of pesticide residues. The economic impact of alternative policies, programs, and practices would be analyzed by ERS. Potential residue exposures in the average populations and specific demographic subgroups would be estimated by HNIS. The data would be available for use by EPA, FDA, and other Federal agencies.

The initial focus would be on fresh fruits and vegetables having substantial markets, pesticides of greatest public health significance, and States producing high volumes of the selected produce. AMS is currently in discussions with EPA, FDA, and the States of California, Florida, Michigan, New York, Texas, and Washington to select the commodities and pesticides to be sampled. The program would be expanded in future years to include more commodities, pesticide residues, and States.

#### 7. Cooperative Regional Research Projects (CSRS)

The Cooperative State Research Service administers and funds cooperative human nutrition research involving land-grant institutions and the 1890 colleges and universities. These projects are regional and may involve ARS and HNIS scientists. The active regional projects in human nutrition are listed.

##### o Western Regional Research Project (W-143)--Nutrient Bioavailability--A Key to Human Nutrition

Our understanding of the dietary factors that affect the digestion and absorption of available form of nutrients, especially vitamins and minerals, is limited. Since some of the nutrients (iron, pyridoxine, calcium, folacin) most affected appear to be marginal or low in diets of certain population subgroups, data on bioavailability becomes of critical importance in establishing sound dietary requirements as well as appraising dietary adequacy. This project involves 10 universities and the Western ARS Human Nutrition Research Center.

##### o Western Cooperative Regional Research Project (W-153)--Economic and Behavioral Factors Associated With Food Supplement Usage (terminated in FY 1990)

The objectives of this project were (1) to identify attitudes and economic factors which result in the use of food supplements and (2) to determine if a relationship exists between attitudes and intentions and actual vitamin/mineral supplementation behavior.



o North Central Cooperative Regional Research Project  
(NC-167)--Health Maintenance Aspects of Dietary  
Recommendations Designed To Modify Lipid Metabolism

The objectives of this project are (1) to determine the effects of dietary omega-3/omega-6/omega-9 fatty acid ratios on physiological factors in humans and experimental animals; (2) to evaluate the effects of caloric intake, expenditure distribution, and dilution on serum lipid levels, metabolism, blood response, and body composition; and (3) to assess the effects of varying levels of dietary minerals on blood lipoproteins. This study involves collaboration among 10 universities and 2 ARS centers.

o Northeast Cooperative Regional Research Project  
(NE-172)--Nutritional Assessment of Older Adults:  
Diet Intake and Biochemical Studies

The objectives of this regional project are to (1) assess the validity of methods of determining food intake and study factors affecting food intake in older adults; (2) evaluate biochemical methods for measuring iron, magnesium, protein, and amino acid status of older adults; and (3) compare and integrate biological, cultural, and sociological measurements as indices of nutritional status in the elderly. This project involves researchers from nine states, ARS and HNIS.

o North Central Cooperative Regional Research Project  
(NC-200)--Behavioral and Health Factors that Influence  
the Food Consumption of Young Adults (to be initiated in  
FY 1991)

The objectives of this project are (1) to identify traits, behaviors, concerns, and perceptions that influence the food consumption decisions of young adults, and (2) to determine the influence of cultural, behavioral, and perceptual factors, and their interactions, on the diet of young adults. This project will involve collaboration among scientists from five universities plus HNIS.

## 8. FSIS/ES Cooperative Efforts

An Extension Service/FSIS working group has been established to facilitate joint projects. The working group will be identifying resource gaps, mutual project ideas, and program impact and will be providing input on new and existing program resources.

## C. Coordination With the Private Sector and International Organizations

### 1. National Healthy Mothers, Healthy Babies Coalition (HM,HB)

The HM,HB Coalition is an informal association of professional, voluntary, and governmental organizations with a common interest in maternal and infant health. Coalition members work to encourage collaborative efforts involving the public and private sectors in the promotion of breastfeeding and to achieve the health objective for the Nation to increase the proportion of women who breastfeed. Most of the Coalitions' program development is conducted through subcommittees. Subcommittees which have a representative from FNS are Breastfeeding, Adolescent Pregnancy, and Low-Income Women; other subcommittees are Oral Health, Substance Use During Pregnancy, Injury Prevention, and Genetics. The Coalition has quarterly membership meetings and publishes a quarterly newsletter.

### 2. Committee on Nutritional Status During Pregnancy and Lactation

This National Academy of Sciences Committee evaluated and documented the current scientific evidence and published recommendations pertaining to dietary intake and nutritional status during pregnancy and lactation. HNIS has provided the Committee with information about USDA food consumption survey data relative to pregnant and lactating women.

### 3. Committee on Pesticides in the Diets of Infants and Children

The National Academy of Sciences (NAS) in 1988 selected Dr. Robert L. Rizek, HNIS, USDA, to serve on the Committee on Pesticides in the Diets of Infants and Children. This Committee was set up following a congressional mandate to NAS to study the scientific and regulatory issues pertaining to pesticides in the diets of infants and children. The Committee report will be issued later this year. Dr. Rizek was selected for the Committee because of his expertise on food consumption methodology, food consumption surveys, and nutrient data banks.

### 4. ARS Nutrient Composition Laboratory and HNIS Nutrient Data Research

There continues to be a very close working relationship and interaction between the ARS Nutrient Composition Laboratory (NCL) and the HNIS Nutrient Data Research Branch in planning and conducting food composition studies and in compiling and documenting results. NCL distributes and evaluates test sample analyses as part of the HNIS contractor selection process for food composition analyses. NCL and HNIS are part of an international collaborative research study evaluating methods of dietary fiber analysis being conducted in laboratories in the United Kingdom, Canada, and the United States.

### 5. Nutrition Education Interactions

HNIS serves as the USDA representative to Project LEAN (Lowfat Eating for Americans Now), a national health promotion program sponsored by the Kaiser

Family Foundation, designed to help Americans lower their intake of dietary fat. HNIS represents the Department on the Cooperating Group for a medical education program, "Rx Nutrition: Good Health In Practice," for the 67,000 primary care physicians nationwide. The American Red Cross 12-hour nutrition course, developed cooperatively with HNIS and ES, continues to be used in Red Cross Chapters nationwide to interpret the Dietary Guidelines concepts in practical, interesting ways. This course has been shown through extensive evaluation to be successful in improving knowledge and food selection behavior. A Nutrition Education Task Force composed of Government and industry representatives continues to meet quarterly under the direction of FDA with extensive participation by HNIS.

#### 6. Food Supply Information

ERS cooperates with many commodity trade organizations and industry groups in the process of collecting and analyzing food production and consumption data. In addition, major procedural changes instituted by ERS are submitted to industry experts for comments prior to institution.

ERS also provides OECD with U.S. annual data concerning the supply and utilization of each major food commodity consumed in the United States.



## D. Advisory Groups

### 1. Human Nutrition Board of Scientific Counselors (HNBSC)

Resolutions passed by the USDA Human Nutrition Board of Scientific Counselors at their annual meeting on February 22-23, 1990:

#### o Resolution 1, Relating to Dietary Guidelines:

Resolved that the Human Nutrition Board of Scientific Counselors commend the Dietary Guidelines Committee for their efforts in updating the Dietary Guidelines for Americans. The Board encourages the Guidelines Committee to simplify the take-home message to the public. We suggest emphasizing or highlighting the effect that maintaining healthy weight by eating a variety of foods (current points Nos. 1 and 2) can have on health and nutritional status of Americans. This could be accomplished by graphics or illustration techniques. We would also wish to point out an inconsistency in one of the proposed guidelines related to starch and fiber. Switching to specific foods is inconsistent with the other proposed guidelines stated on the cover. As proposed, this change in emphasis actually excludes major sources of starch and fiber in our diet, i.e., potatoes, rice, and beans. The text within the booklet also should be reworded to reflect this oversight.

#### o Resolution 2, Relating to Need for Manpower Training in Human Nutrition:

Resolved that, in view of the continued increased awareness of the diet and health issue and the need for trained manpower, the Human Nutrition Board of Scientific Counselors renews its support of the USDA Food and Agricultural Sciences National Needs Graduate Fellowship Grants Program in the area of human nutrition.

#### o Resolution 3, Relating to Nutrition Labeling:

Resolved that, since USDA has regulatory authority over foods containing 2 or more percent red meat and poultry, and is concerned about ways to improve and standardize food labeling, the Human Nutrition Board of Scientific Counselors supports the concept of nutrition labeling as a vehicle to allow consumers to select an appropriate diet to help meet their needs, and applauds the efforts of the AIN/ASCN Committee on Food Labeling and generally agree with the "platform assumptions" included in their January 1990 draft report.

#### o Resolution 4, Relating to Competitive Grants in Human Nutrition:

Resolved that the Human Nutrition Board of Scientific Counselors express its support of the plan for the National Initiative on Agriculture, Food, and Environment and renews its advice to the Secretary that he continue to strongly support the human nutrition program of competitive research grants. We are encouraged by the increase in funds for human nutrition research for FY 1990 and by the anticipated increase in the President's budget for FY 1991 which would further increase funds in this specific area as a part of the Research Initiative.

- o Resolution 5, Relating to Priorities in Collection of Food Consumption Data:

Resolved that the Human Nutrition Board of Scientific Counselors reaffirm its support for increased priority in food consumption data collection on aging Americans and other populations at nutritional risk.

- o Resolution 6, Relating to Need To Better Inform Consumers about Nutrition and Food Safety Issues:

Resolved that, in view of the need for more risk assessment, risk communication, and behavioral science research, the Human Nutrition Board of Scientific Counselors at its next meeting identify focused, socially relevant, mission-oriented areas of research in human nutrition and food safety, as well as funding strategies, which should receive priority attention.

- o Resolution 7, Relating to Need for Improved Human Nutrition Research Facilities at Beltsville:

Resolved that the Human Nutrition Board of Scientific Counselors, having previously visited the Beltsville Human Nutrition Research Center and conducted its programs and facilities, reaffirm its position and urges the Secretary to include, in fiscal year 1992 budget, a request for planning funds for a new facility for human nutrition research at Beltsville in cooperation with the National Institutes of Health.

- o Resolution 8, Relating to Retiring Board Members:

Resolved, that, in recognition of the unique insight and valuable advice provided during their 6 years of service as original members of the Human Nutrition Board of Scientific Counselors, the remaining members of the Board wish to express appreciation to retiring members: Lloyd J. Filer, Jr., M.D.; R. Gaurth Hansen, Ph.D.; K.C. Hayes, Ph.D.; H. David Hurt, Ph.D.; James Kirk, Ph.D.; and Patricia B. Swan, Ph.D.

## 2. National Advisory Council on Commodity Distribution

This Council was established in 1988 through P.L. 100-237. The Council meets twice a year and provides an annual report to the President and several congressional committees.

In April 1990, the Council recommended for its Second Annual Report to the President and Congress that USDA provide additional nutrition education nationwide, stressing a moderate and balanced diet based on the major food groups. More specifically, it was suggested that USDA seek ways to provide more nutrition education to all participants of USDA-supported food programs.

## 3. National Advisory Council on Maternal, Infant, and Fetal Nutrition

The Council met on August 8-10, 1990, in Alexandria, VA, to develop recommendations for its 1990 Biennial Report to the President and Congress on

how to improve program operations for the WIC and CSF Programs. Recommendations focused on three major categories: Management of Resources, Quality of Service to Clients, and Promotion of Nutrition. The report was released December 1990.

#### 4. Federal Dietary Guidelines Advisory Committee

A nine-member Federal Dietary Guidelines Advisory Committee was established by USDA and DHHS in 1989 to review recent scientific evidence on diet/health relationships and determine if revision of the 1985 edition of "Nutrition and Your Health: Dietary Guidelines for Americans" is warranted. The consensus of the Committee was that revision was warranted. They made recommendations for revision and the rationale for them to the Secretaries of USDA and DHHS in a 50-page report entitled "Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 1990." These recommendations were used by the two Departments to prepare the third edition of the Dietary Guidelines for Americans issued in 1990.



## VI. BENEFITS

The USDA Human Nutrition Research and Education Program, described in its 1986 report to Congress, required the determination of nutrient needs and food sources of these nutrients, the monitoring of food consumption practices and the nutritional qualities of diets, and the development of information techniques to foster the selection of healthful diets by Americans. In pursuing this course, the program has embodied problem-oriented research coupled with research-based nutrition education of professionals, producers, and the public. Sound nutrition education efforts have led to changes in consumer demand, which, in turn, has provided industry with the opportunity to market modified and nutritionally improved food products. To the extent that adequate information is available, and no knowledge gaps remain, this is the way new discoveries in nutrition can be instrumental in bringing about improvements in the food supply of importance to the health and well-being of Americans.

In recent years, scientific investigations, such as those reported here, have clearly shown that what we eat can affect our health. In fact, most authorities agree that our diets can affect the risk of 5 of the 10 leading causes of death in the United States, including coronary heart disease, stroke, atherosclerosis, diabetes, and some types of cancer. The prevention of obesity is also due to greater energy expenditures than intakes. In addition, several other problems, such as dental caries, bone strength, performance, and immune response can be influenced by nutrition.

Benefits of improved diets and better nutrition are improved health and a longer, more active and satisfying life. The development of new food and nutrition knowledge as well as the application of existing knowledge are essential to the alleviation of diet-related health problems. The USDA, through its several nutrition research and education activities, is developing information to fill in knowledge gaps and helping to apply the knowledge important to the alleviation of diet-related health problems and for better performance and well-being of Americans.

New food and nutrition knowledge from USDA research benefits the many segments of the population who produce and market food and who educate and provide health services to the public. It is required by policymakers who formulate food assistance, public health, and education programs. It forms the information base for dietary guidance for the public.

The USDA Food and Nutrition Program has contributed to up-to-date analytical data on the nutrient composition of foods in the forms that people use to meet their nutritional needs. When the long-range objectives have been achieved, even more reliable information will be readily available to determine the kind and amounts of nutrients in foods and diets. The technology is available to improve the nutritional values of many foods. Industry has also improved guidelines on changes in nutrient content of foods arising from processing, so that products might be improved where indicated.

Advances in technology have made it possible to minimize nutritional inadequacies of most diets or diet patterns. The consumer benefits from knowledge of the nutritional usefulness of foods and can be assured of better nutrition where some foods have been improved. Health professionals,

nutrition educators, food program directors, and the food service industry benefit from additional nutritional knowledge. The USDA agencies involved in supplemental feeding have an improved scientific basis for food selection in their food distribution or food programs aimed at improving nutritional health.

For the consumer, better health may be enjoyed through improved nutrition resulting from diets providing the right amount and types of nutrients. People are better able to achieve their full genetic potential, including resistance to disease, intellectual development, and physiological well-being. These can be significant consequences of improved nutrition.

The potential economic benefits from improvement of human nutrition that results from research findings about food needs include significant reduction of health costs for heart and vascular problems, reduced hospital costs in connection with respiratory and infectious diseases, reduced costs associated with arthritis, savings from less expenditures for dental services, savings for people with eyesight problems, and significant reduction of health costs for digestive problems and losses associated with alcoholism. Additional problems where improved nutrition can have tangible benefits include anemia, mental illness, infant mortality, aging, diabetes, osteoporosis, obesity, kidney and urinary problems, and certain cancers. There can also be increased economic benefits for different segments of the population, through increased working efficiency, an increase in the productive lifespan, and reduction in days lost from work and school.

Considerable progress has been made, but many knowledge gaps remain. Undoubtedly, benefits can be expected to be derived from improved nutritional progress that will result during the next decade. Some of these may be because physicians are able to improve health care, because food producers or processors are able to improve the nutritive value of food products, because educators are able to guide families into improved dietary practices, or because Government agencies are able to deliver better nutritional services in the administration of food programs for the needy or those at risk.









